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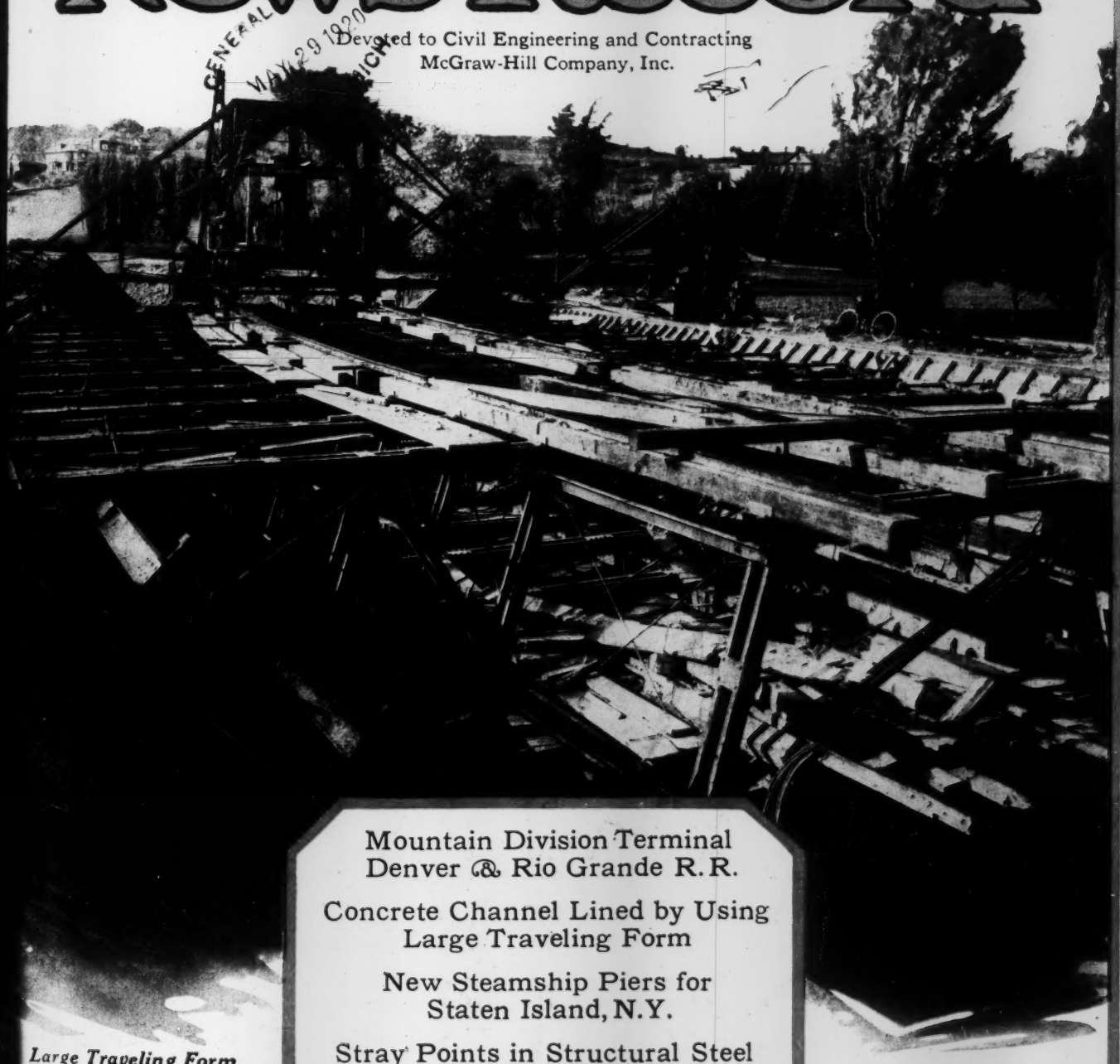


Large Traveling Form Lays Concrete Channel Lining

Mountain Division Terminal Denver & Rio Grande R.R.

Concrete Channel Lined by Using Large Traveling Form

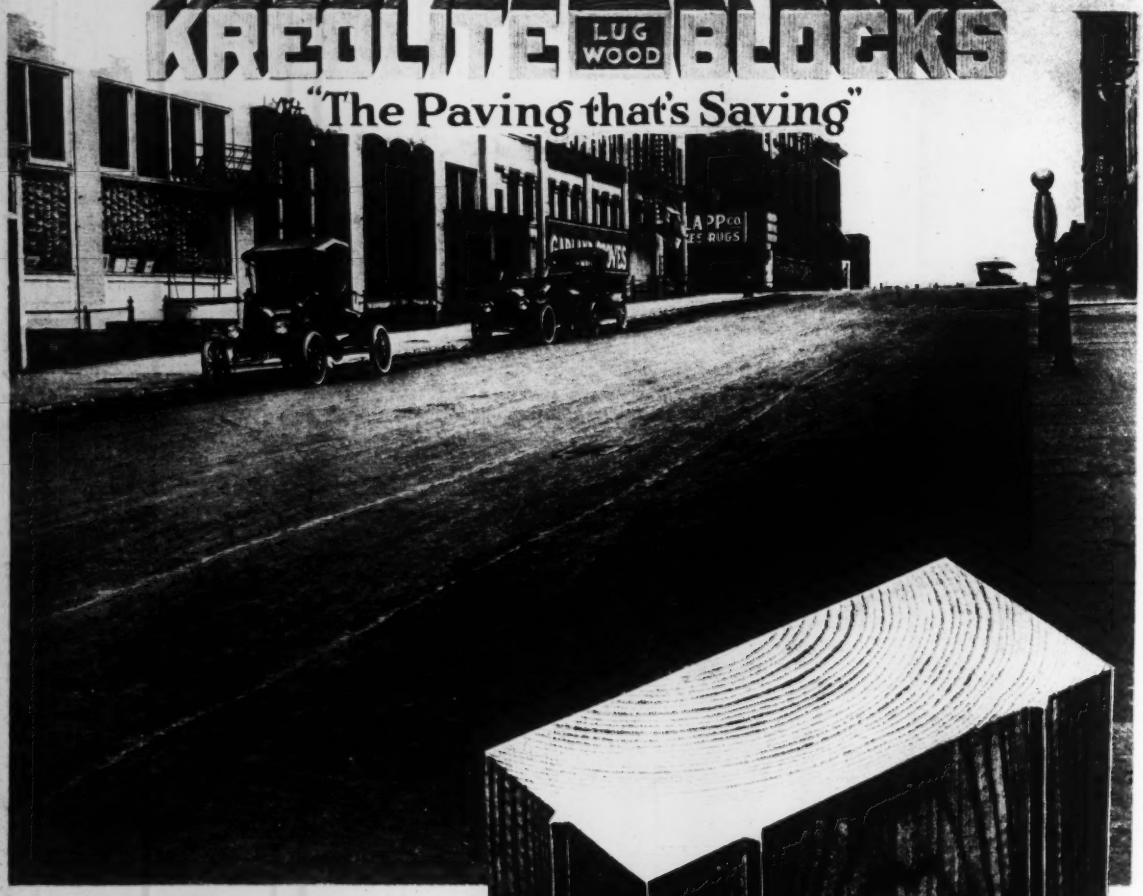
New Steamship Piers for Staten Island, N.Y.

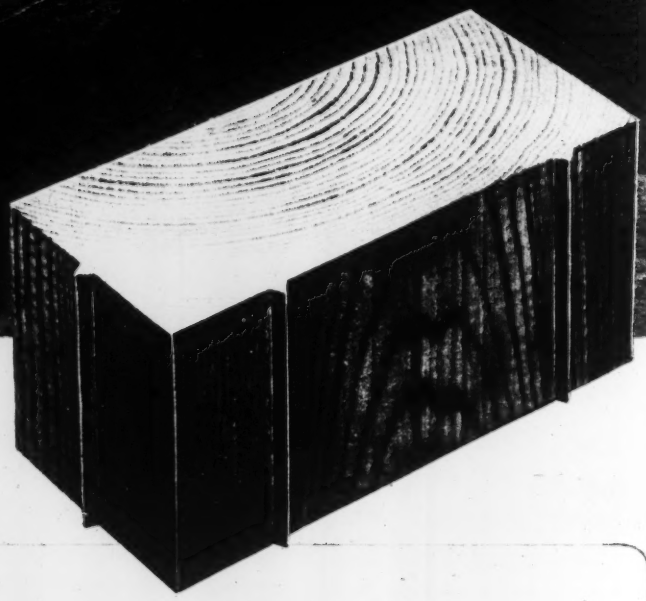
Stray Points in Structural Steel Design—Part I
By R. Fleming

Outlet Sewer Reconstruction in St. Louis
By W.W. Horner

KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"





No Wear After Years of Service

The Kreolite Lug Wood Block pavement on Jackson Ave., Toledo, Ohio, was laid in the early summer of 1912. The above picture was taken in April, 1920.

There is a noticeable freedom from cobbling, or wearing at the joints. This is especially interesting in view of the fact that the street is very heavily traveled and is on about a four per cent grade.

The lugs on the blocks provide ample room for expansion, preventing any buckling or bleeding and also offer a foothold for horses. Team owners report that their horses are able to get a secure foothold on this pavement in spite of the grade.

Evidence of this kind tends to prove our claim that the lugs "make a good block better." There are now over a million square yards in service in all parts of the United States.

Write the Toledo Office for further information on Kreolite Lug Wood Blocks, "The Paving That's Saving."

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 84 — NEW YORK, THURSDAY, MAY 27, 1920 — Number 22

Time Needed for Discussion

IT IS desirable that adequate opportunity be given delegates to the Organizing Conference of engineering societies in Washington next week for a full and free expression of opinion from the floor. From a study of the tentative program published in the news columns of last week's issue, however, it appears that the time for discussion will be very small if all of the listed speakers on a variety of definitely assigned topics are to be heard. Two chief motives evidently have governed the program committee: First, a desire to consider the business of forming an engineering federation, and, second, to furnish to delegates, through the medium of specially chosen speakers on such topics as the engineer in public affairs, licensing, publicity, etc., inspiration and a broad outlook upon the opportunities which lie in the proposed unification of engineering effort. The program announced last week was tentative and it is understood that it will be so revised as to give more time to the proposed federation—which is the avowed object of the conference. This is a move in the right direction.

New York Joins Licensing States

WITH New York added to the states that require engineers to be licensed (see p. 1031, May 20), half the battle is won. Every state added to the list, and particularly every large state, is bound to lead many opponents of licensing into advocates. As Mr. Drayer said in his recent report as secretary of the American Association of Engineers, "the time is nearly here when the engineer in the state not having a license law will be under considerable handicap." One reason is that the license laws carry reciprocity clauses. An engineer in a state without a license law will have to secure a separate license in every state that has one, or else be debarred from practice there; but if he hold a license from his own state, the way is made easy for him to practice in any state that has a license law with reciprocity provisions. Ultimately, wise license laws, well administered, will raise the status of the engineer in public esteem and increase the solidarity of the engineering profession.

Raising the Freight Blockade

SUCH radical steps have been taken to relieve the railroad tie-up, since we commented on the situation last week, that progress toward a temporary solution should be noted. The Interstate Commerce Commission has begun to use the executive powers granted by the Transportation Act in time of emergency and apparently has secured full co-operation from the private managements through the agency of the American Railroad Association and the Association of Railway Executives. Equipment is being "relocated" on a large scale to the sections of the country from which essentials must be quickly shipped and the inter-line embargo —against receiving freight from foreign lines—appears to be vanishing as a competitive measure. When it is considered that new freight equipment and locomotives now on order will not be delivered until between the first of August and October, there is no great hope of immediate solution being found in the Government-financed equipment orders under discussion in Washington. This offers none too bright a prospect to many branches of the construction industry, but steps now being taken should soon afford relief in many quarters.

The St. Louis Bond Vote

THE defeat of five-sixths of the proposed $24,000,000 bond issue at St. Louis on May 11 (see p. 1080) must be interpreted in the light of the fact that the state constitution requires a two-thirds majority vote to carry bond issues. The actual majorities were from 61 to 69 per cent, with an average of 10,000 more votes for than against the various items. Considerably less than half the voters who registered went to the polls. In view of these facts it cannot be said that the people of St. Louis were strongly protesting against municipal outlay during a period of high prices. A goodly majority of those who took the trouble to go to the polls voted for every item on the long list. This action is in strong contrast with the votes a few weeks earlier on public improvements at Chicago and Cleveland, where strong disapproval of every item voted for was recorded, with the exception of hospital facilities at Cleveland. The difference may well have been largely due to the care with which the Cleveland bond program was formulated after extended consideration of all the public improvement needs of the city and with the advice of a committee representing various civic and commercial organizations.

Road Subgrade Study

REPAIR of disintegrated road surfaces as practiced ten years ago and today has an analogy, it appears, in the ways of the old medical practitioner and those followed by the modern physician. The pill and powder panacea is fast being discredited; now the diagnosis is the thing. The modern practitioner's first move is to accumulate a mass of facts, which, to the layman and particularly to the patient, appear wholly irrelevant. These facts form the "history" of the case and upon it and his years of research the physician relies to cure not only existing ills but any succeeding ones. During the past few months road surfaces that were believed to have only begun their useful lives have entirely disintegrated. Failures have been such that more than superficial diagnosis is a necessity. The histories of road failures must be obtained to guide future design and insure healthy pavements. This is a fact all realize but few are the highway departments that have reached

that stage in their development where intensive research is possible. Highway engineers, therefore, generally will be interested to know that the Bureau of Public Roads, at the instance of its chief, Thomas H. MacDonald, has undertaken the collection of the "histories" of anæmic highways. Details of the plan whereby this information is to be secured are given elsewhere in this issue. Road failures are to be examined where it is apparent the subgrade is responsible. The entire field organization of the bureau is to aid the testing division in the work. It is clear that results obtained will be far-reaching, since the investigation will cover roads of every type, built under every degree of engineering difficulty, upon a variety of subgrades, and where temperature ranges are widest.

An Unresponsive Answer

ANSWERING the question "whether an engineer or an architect should have charge of the design and construction of bridges and other important structures," Engineering Council this week makes public the conclusions reached by one of its committees in joint session with a committee of the American Institute of Architects, as reported in the news section of this week's issue. The answer is unresponsive. It does not meet the issues of the Pittsburgh bridge case, out of which the question arose, and it is not likely to promote a better understanding of engineering responsibilities within the profession or among the public which it serves. Other organizations of engineers that have studied the relation of the question to safety and sound public policy have expressed quite definite conclusions. It was hardly to be expected that Engineering Council would do less than did, for example, the American Institute of Consulting Engineers. A broad, yet clear and forceful, statement of principle was due. Instead, the report confines itself to easy generalities. It says that "the special conditions surrounding each case should determine whether an architect or an engineer should be selected to have charge." Doubtless it was not lack of courage that led the committee to this form of statement. But it may be that the key lies in a subsequent passage, to the effect that "whether the engineer is chief and the architect associate or vice versa is an administrative detail of relative unimportance." If the committee really interpreted its problem as concerning a mere administrative detail the tenor of the report is explained. But we fear that if the engineers of the country are to have no other guidance than such pronouncements, they will prefer to depend on their individual judgment.

Railway Service and Rates

THE ease of descent into poor conditions and the difficulty of ascending again to normal or improved conditions (the "facilis descensus" of our Latin school days), as noted in regard to public utilities in *Engineering News-Record* of May 6, p. 890, is illustrated forcibly by the present railway situation. An abstract of the report of the Division of Capital Expenditures, United States Railroad Administration, appears on another page of this issue. Failure of Congress to make an appropriation for railway work in March, 1919, and failure of the Railroad Administration to provide adequate maintenance, have resulted in postponed improvements, insufficient equipment and depreciated property in many cases. Thus, when the railways were returned to their owners they were, on the whole, below normal condition and their expenses had been increased enormously. It is evident, therefore, that they have before them a long and heavy pull up grade to reach satisfactory conditions of service and finance. A railway system that is efficient and a safe investment is a necessity for progress and prosperity, but funds are needed for efficient service and the payment of expenses. Although increased freight rates appear to be generally recognized as inevitable under the circumstances, there is a tendency to claim exemptions for various industries. But such rates should be accepted without attempts to avoid an equitable share of the burden that must be imposed if the railway system is to function successfully, affording the service that is necessary to make possible any greatly increased production.

New York City's Port Policy

MUCH criticism has been leveled at the Dock Department of the City of New York for the inadequacy of the new steamship pier layout on Staten Island now just starting construction. Some of this has been ill considered—mere sheeplike following of the general principle that freight-handling equipment is of itself a manifestation of modernism in steamship pier design. But a great deal of the objection is based on the best judgment of engineering talent in harbors and terminals and finds expression mainly in the contention that the 125- and 130-ft. piers are too narrow. It is hoped that the publication in this issue of the details of the project and the defense of the conception by the city officials will result in a discussion of the criticised elements of the design, which, though probably of small effect on the future of the scheme, may serve to clarify engineering opinion on the subject.

It should be said, however, in advance of such a discussion that the position of the city authorities is clear. First and foremost, they represent only the City of New York; so far as they are concerned, the port does not exist west of the state boundary line. Nor do they choose to contemplate or foresee any future rearrangement of conditions of control. That a consideration of the port as a whole might result in benefit to their city and state does not enter into their calculations. They are committed to a port of the City of New York, regardless of geographical or economic alliances. This position inevitably leads to the conclusion that the port must always be a lighterage proposition and the design and layout of piers are governed by this fact. Finally, they hold that whatever is is right, that the present rate system in New York harbor will prevail and that the steamship companies will continue to shoulder the cost of freight transfer onto the railways, who in turn pass it on to the shipper. Therefore they prefer to accept the opinions of the steamship interests as the governing factor in pier layout regardless of the effect of such a policy in adding to the final cost of freight transfer in the port.

That this is a narrow view which will ultimately react against the best interests of New York City seems obvious. However, any consideration of the Stapleton development must take it into account. Engineering has been forced into the background by political expediency.

The Proposed Engineering Federation

ANSWERS to the call for the Organizing Conference of engineering societies to be held in Washington next week indicate that at least 100 delegates representing nearly 90,000 engineers will participate.

The stage is set, therefore, for the most important deliberative gathering that engineers have ever planned. It is essential, if the best interests of the profession are to be served, that the views of technical men on the proposed federation of engineering societies shall be thoroughly representative. Any decision reached or any plan promulgated at Washington must reflect the best thought of engineers throughout the country, and not in one or more sections. The question to be decided by the profession is a national one. It calls for a nation-wide representation of engineers at Washington. While the acceptances to the call thus far received assure the success of the meeting, it is desirable that all societies which have not already done so take steps immediately to insure participation in the deliberations by their delegates. The time is short. The situation demands quick action.

For years past a national, all-inclusive organization of engineers has been considered. The topic has been discussed frequently in the presidential addresses of the heads of the largest national societies, but nothing resembling concerted action by these bodies was done until Engineering Council, representing the directorates of the four founder societies, was formed several years ago. Meanwhile the American Association of Engineers, from small beginnings in 1915, grew apace until it now shows a membership of 17,000. Apathy on the part of the founder societies toward the human and the economic problems of the engineer gave birth to the new organization, which is designed to supply to its members the kind of service which the older societies were negligent in providing. Then followed the appointment by the founder organizations of "development committees" and Joint Conference Committee representatives, the movement toward a national federation of engineering societies culminating in the announcement of the Organizing Conference to be held next month.

The present situation is a complex one, especially in view of the recent defeat by the members—not the directorate—of the American Society of Civil Engineers of the third proposal in its questionnaire-ballot covering the "comprehensive organization" plan offered by the Joint Conference Committee's report. Underneath the cross-currents of individual judgment, however, it is clear that there is a strong general sweep of opinion toward the acceptance of some means for securing unified action by engineers in civic, economic and other non-technical matters. The overwhelming affirmative vote on Questions 1 and 2 of the American Society of Civil Engineers ballot is strong evidence in support of this belief. The big question which the Organizing Conference must answer, therefore, involves not the end, but rather the means toward that end.

Opinion is very sharply divided on two alternative projects. One group of engineers believes that an entirely new organization, or possibly one involving the reconstitution of Engineering Council along more democratic lines, should be created to effect the unification of the profession by means of a federation. The other group holds that the American Association of Engineers, first in the field of welfare activities, now a going concern with a large membership and organized primarily for non-technical work, is the logical agency by which the so-called welfare activities should be handled. The association will send 17 delegates to the Washington conference. It is possible that they, or the representatives of other organizations, may bring forward some plan whereby the American Association of Engineers and the proposed federation may be able to work effectively along non-conflicting lines. The acceptance of such a plan, if it be possible to devise one, would clear the atmosphere and open up the way for real constructive work.

Recognition of the aggressive and efficient record of the American Association of Engineers cannot be denied, but consideration must be given to the potential influence which would lie in an association of all of the country's engineering organizations, representing more than 100,000 engineers, as against a smaller body of individual members. On the one hand, the association of individual members would be closely knit and capable of direct action. On the other, in the larger organization, the weight of numbers, in addition to the prestige of the nation's leading engineers, would be a powerful political factor, provided that the national societies are whole-heartedly in favor of the movement. If opinion in the founder societies generally is divided —as it was in the case of the American Society of Civil Engineers—the federation, if endorsed, would labor under the handicap of opposition from what may be termed a group of "irreconcilables." The federation movement must either be generally and enthusiastically supported or it must be abandoned. A half-hearted acquiescence in the project will result only in failure.

The real sentiment of the rank and file of American engineers toward this vital project of a federation cannot be accurately determined by decisions of boards of directors and executive committees or by opinions of uninstructed delegates returning from the Washington meeting. Only after a broad, democratic expression of opinion by letter ballot to the members of all organizations participating in the Organizing Conference and a wide publication of the proceedings of the meeting can the future of the proposed federation be fairly decided. The American Society of Civil Engineers is the only national body which has taken such a referendum vote, the result being the defeat by a close margin of the proposal to accept the "comprehensive organization" outlined by the Joint Conference Committee. Following the Washington meeting, other organizations must be canvassed in the same democratic way as was followed by the civil engineers. As a matter of fact, the civil engineers will again vote upon the question of the federation by letter ballot and will have the benefit of mature consideration as a basis for revoking or endorsing their original action.

It remains for the Washington conference, therefore, to demonstrate what means engineers wish to adopt to achieve the end of unified action. The decision to be made is a momentous one. It should be made only after a thorough realization on the part of the profession of the various factors which enter into the problem. When the next questionnaire ballot to engineering society members comes it should propose something so definite that no one can offer as an excuse for not voting or for voting no that he does not know what he is asked to vote on.

Stray Points in Structural Steel Design — Part I

Practical Notes on Spacing of Tie Rods in Floors, Weakening of Beams by Flange Holes, Excessive Horizontal Shear, Use of Average Test Results, and Beam Deflections

By R. Fleming
American Bridge Co., New York City

THOUGH the principles governing steel design are well defined, the structural engineer is often obliged to settle questions regarding which information is scattered and fragmentary. He also meets conditions where practice is varied and divergent. These may be called "stray" points in structural design, some of which will be taken up in this article.

Goodman, in the preface to his "Mechanics Applied to Engineering," says:

> There are comparatively few engineering problems in which the data are known to within, say, 5 per cent, hence it is a sheer waste of time for the engineer in practice to use long complex methods when simple, close approximations can be used in a fraction of the time.

Accuracy is a relative term. The survey of a prairie farm and of a valuable city lot may each be termed accurate, but not to the same degree. In structural work certain stresses are negligible. The engineer, however, should know the degree to which such stresses affect calculations. In all approximate stresses the degree of approximation should be well understood. It would be of lasting benefit to a designer of structural steel if he would investigate once for all the deflections due to shear and variable moment of inertia, the strength of beams with flanges unsupported laterally, the value of countersunk rivets, the design of lattice bars, and kindred subjects.

Spacing of Tie Rods for Floor Arches

How shall tie rods for tile arches as shown in Fig. 1 be spaced? The thrust, T, per lineal foot of arch is determined by the usual formula,

$$T = \frac{3 w L^2}{2 r}$$

in which w = load per square foot uniformly distributed, L = span in feet and r = rise of arch in inches. Practice varies from using tie rods in all bays to omitting them in all but the outer bays and the portions of bays adjoining floor openings. An article, "Tie Rods for Floor Arches," by F. N. Kneass, *Engineering News*, March 18, 1915, p. 518, and discussions in subsequent numbers take up the subject at length. The present writer recommends that tie rods be placed in all bays, calculated for a tensile stress of 25,000 lb. per sq.in. for intermediate and 12,500 lb. for outer bays and portions of bays adjoining openings. For cases similar to Fig. 1 he considers the rise of arch to be the distance from the center of tie rod to top of tile. However, with the low working stresses assumed and the fact that the designer may not know the depth of tile that will be used, the writer believes it is permissible to use the depth from tie rod to top of beam as rise of arch.

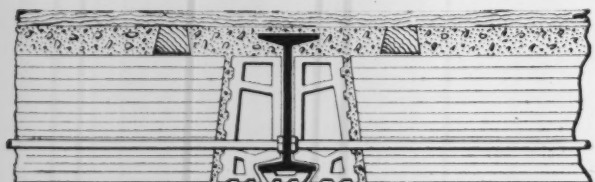


FIG. 1. POSITION OF TIE-RODS IN TILE FLOOR ARCH

A point often neglected in the design of beams for arch floors is the thrust stresses thrown into the outer beams and the channels around openings. These are additional to those due to vertical loading. Approximate methods for combining these stresses may be found in the Cambria and Carnegie handbooks.

Weakening Effect of Flange Holes in Beams

Bolt holes are often punched or drilled in the flanges of beams without any thought of a reduction of strength of the section at which they are located. If the holes are near the point of maximum flange stress the strength of the beam is materially lessened. For standard beams and channels the reduction of strength in a section due to holes in the flanges at that section is shown in Table I.

Where beams have not been designed with section of flange holes omitted, holes should be located so as not to weaken the beam. Fig. 2 shows the percentage of reduction of maximum bending moment at distances from the center of a beam under uniform load and under central concentrated load.

The Horizontal-Shear Danger

Beams of short span uniformly loaded and beams with heavy concentrated loads near the supports may have sufficient strength for bending moment but be insufficient for horizontal shear. (Of course, the vertical and horizontal shearing stresses at any point of the web have the same value, but it is better for the structural engineer to think in terms of horizontal shear. He will not then be confused by doubts concerning the shearing strength of the flanges). Fig. 3 shows the design of a crane-runway support found weak in horizontal shear. The defect was remedied by changing the light 15-in. channel to one of heavier weight and

TABLE I. REDUCTION OF STRENGTH IN BEAM SECTION DUE TO HOLES IN FLANGES

Beams or Channels	Diameter of Bolt, In.	Diameter of Hole, In.	Percentage of Reduction, One Hole in Flange	Percentage of Reduction, Two Holes in One Flange	Percentage of Reduction, One Hole in Each Flange	Percentage of Reduction, Two Holes in Each Flange
Beams In. Lb.						
6 x 12.25	¾	⅞	15.9	31.5	18.1	36.1
7 x 15	¾	⅞	14.4	28.1	16.1	32.2
8 x 18	¾	⅞	14.6	30.0	17.5	35.0
9 x 21	¾	⅞	13.9	27.7	16.1	32.3
10 x 25	¾	⅞	12.5	25.1	14.7	29.5
12 x 31.5	¾	⅞	11.3	22.6	13.4	26.7
15 x 42	¾	⅞	9.8	19.6	11.8	23.6
18 x 55	¾	⅞	10.0	20.0	12.2	24.4
20 x 65	¾	⅞	9.6	19.2	11.7	23.4
24 x 80	¾	⅞	8.6	17.2	10.4	20.8
Channels						
6 x 8	¾	⅞	23.2	.....	28.2	.....
7 x 9.75	¾	⅞	21.5	.....	26.3	.....
8 x 11.15	¾	⅞	23.5	.....	28.6	.....
9 x 13.25	¾	⅞	20.1	.....	24.7	.....
10 x 15	¾	⅞	20.1	.....	25.0	.....
12 x 20.5	¾	⅞	19.8	.....	24.4	.....
15 x 33	¾	⅞	16.0	.....	20.1	.....

thicker web. From the writer's personal knowledge there are instances in existing structures where beams are designed for bending only and are weak in horizontal shear. One such instance is in a prominent public building where granite columns rest near one end of floor beams. In this case the weakness in shear is further emphasized by the fact that the usual standard connection angles are used.

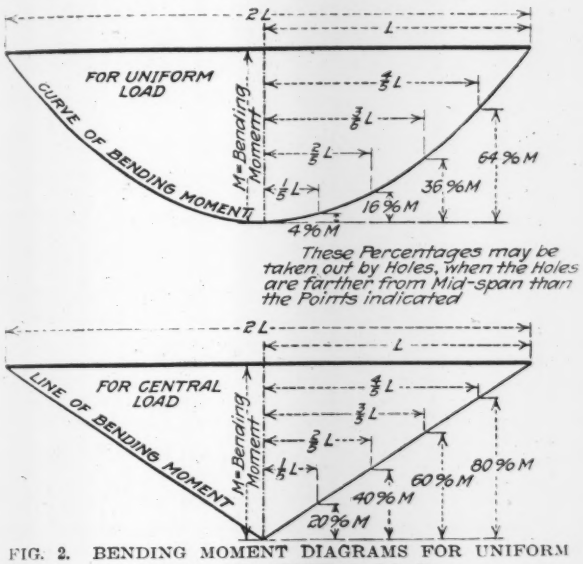


FIG. 2. BENDING MOMENT DIAGRAMS FOR UNIFORM LOAD AND CENTRAL LOAD

The maximum intensity of longitudinal shear in beams is at the neutral axis. Table II gives this intensity in coefficients of the total vertical shear at the section considered.

Using Average Values of Test Results

Discrimination must be exercised by the engineer in making use of the "average" value of strength found in a number of test pieces. In a series of timber tests the horizontal shearing resistance in 12 pieces ranged from 188 to 497 lb. per sq.in. with an average of 370 lb. In another series the values in 4 pieces ranged from 293 to 505 lb. with an average of 364 lb. per sq.in.

The reports of any series of tests should give individual results if practicable or in some way give the reader an indication of the variability of the phenomena involved. It is only when variations are slight that conclusions may safely be based upon average values. What would be thought of the bottom chord of a bridge composed of four bars, two iron and two steel, equal in area of cross-section and proportioned according to the average tensile strength of iron and steel?

The Deflection of Beams

Table III is given for reference. All the formulas, except those of Column 5, are for deflection due to flexure. All beams are assumed to have a constant moment of inertia except those of Column 4.

Rankine sixty years ago showed that the deflection of a beam due to shearing stress is so small compared with that due to the bending action of the beam that it may safely be neglected. For illustration, the deflections due to both flexure and shear of a number of beams fully loaded are shown in Table IV.

The deflections, Δs, are determined from the formulas

TABLE II. HORIZONTAL SHEAR IN BEAMS. FORMULA $Sh = \frac{M_s V}{It}$

Section I-Beam In. Lb.	I	t	M_s	Sh
6 x 12.25	21.8	0.23	4.2	0.84 V
7 x 15.0	36.2	0.25	5.9	0.65 V
8 x 18.0	56.9	0.27	8.2	0.53 V
9 x 21.0	84.9	0.29	10.8	0.44 V
10 x 25.0	122.1	0.31	14.0	0.37 V
12 x 31.5	215.8	0.35	20.8	0.28 V
15 x 42.0	441.8	0.41	34.3	0.19 V
18 x 55.0	795.6	0.46	51.7	0.14 V
20 x 65.0	1169.5	0.50	68.6	0.12 V
24 x 80.0	2087.2	0.50	101.5	0.10 V
Channels				
In. Lb.				
6 x 8.0	13.0	0.20	2.5	0.96 V
7 x 9.75	21.1	0.21	3.5	0.79 V
8 x 11.25	32.3	0.22	4.7	0.66 V
9 x 13.25	47.3	0.23	6.1	0.56 V
10 x 15.0	66.9	0.24	7.7	0.48 V
12 x 20.5	128.1	0.28	12.4	0.35 V
15 x 33.0	312.6	0.40	25.0	0.20 V

NOTATION: Sh = intensity of horizontal shear.
M_s = statistical moment of section included between the neutral axis and the extreme fibers.
I = moment of inertia of beam.
t = thickness of web.
V = total vertical shear at section considered.

of Column 5 in Table III, by assuming that the whole shearing stress is uniformly distributed through the web of the beam. The web is then regarded as a rectangular prism of b = thickness of the web and d = depth of the beam.

An interesting academic study may be made of shearing-stress deflections. The shearing stress in a beam is not uniformly distributed through the web, but it is possible to calculate the true deflections due to shear in sections for which the true shear distribution is known. Examples of such calculations are given by Fuller and Johnston, "Applied Mechanics" (Vol. II); Morley, "Theory of Structures"; and Tilden, *Engineering News*, Feb. 24, 1910, p. 228. The method is laborious and almost nothing is gained in accuracy; for any beam in Table IV, the difference is less than 1/300 in. from that given.

As to plate girders, Hudson, in his book "Deflections and Statically Indeterminate Stresses," says that in

TABLE III. FORMULAS FOR DEFLECTIONS OF BEAMS

1	2	3	4	5
Beam and Loading	Maximum Deflection in Terms of Loading	Maximum Deflection in Terms of Stress on Extreme Fiber	Maximum Deflection of Beams of Constant Strength and Uniform Depth (Boyd)	Maximum Deflection of Beams of Rectangular Cross Section Due to Shear (Hudson)
Case I—Cantilever Beam. Concentrated load P at free end	$\frac{P l^3}{3 E I}$	$\frac{2 f l^2}{3 E d}$	$\frac{P l^3}{2 E I_m}$	$\frac{6 P l}{5 E_s b d}$
Case II — Cantilever Beam. Load W uniformly distributed	$\frac{W l^3}{8 E I}$	$\frac{f l^2}{2 E d}$	$\frac{W l^3}{4 E I_m}$	$\frac{6 W l}{10 E_s b d}$
Case III—Beam supported at ends. Concentrated load P at center	$\frac{P l^3}{48 E I}$	$\frac{f l^2}{6 E d}$	$\frac{P l^3}{32 E I_m}$	$\frac{6 P l}{20 E_s b d}$
Case IV—Beam supported at ends. Load W uniformly distributed	$\frac{5 W l^3}{384 E I}$	$\frac{5 f l^2}{24 E d}$	$\frac{W l^3}{64 E I_m}$	$\frac{6 W l}{40 E_s b d}$

NOTATION: P = concentrated load.
W = uniformly distributed load.
E = modulus of elasticity for flexure (= 30,000,000).
E_s = modulus of elasticity for shear (= 12,000,000).
I = moment of inertia of beam of uniform cross-section.
I_m = moment of inertia of beam at greatest cross-sectional area.
b = breadth, d = depth, l = length of beam, all in inches.
f = stress in lb. per sq. in. in extreme fiber.

investigating the effect of shear in producing distortion it will be very nearly correct to assume that the web alone resists all the shearing stresses and that the shear is uniformly distributed. Also, that the shearing stresses, in modifying the effect of the flexural stresses in designing, need be considered only for very deep girders subject to very heavy loads. Girders carrying considerable loads are usually designed with the flanges composed of angles extending full length and cover plates of varying length. This is done to make the girder of as nearly constant strength as practicable. The moment of inertia is thus not constant but variable. Maximum deflections are given in Column 4 of Table III for girders of uniform depth and theoretical constant strength. It is noted that deflections are from 20 per cent to 100 per cent greater than for beams with constant moment of inertia. In Cases III and IV, the most common conditions of loading, deflections are 50 and 20 per cent greater.

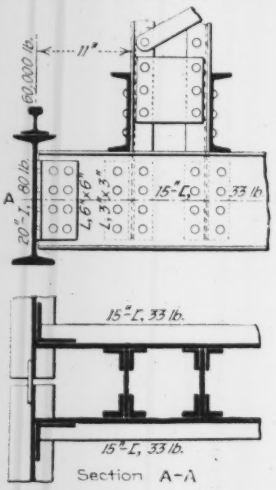


FIG. 3. CRANE-SUPPORT BRACKET IN WHICH WEB SHEAR IS A FACTOR

TABLE IV. DEFLECTION OF BEAMS: FLEXURE AND SHEAR

I-Beams In. Lb.	Span in Feet	Load in Pounds	Distribution	Δf in Inches	Δs in Inches	$\Delta f + \Delta s$ in Inches
8 x 18	5	30,300	Uniform	0.050	0.011	0.061
8 x 18	10	15,150	Uniform	0.200	0.011	0.211
8 x 18	15	10,100	Uniform	0.449	0.011	0.460
8 x 18	5	15,150	Middle	0.040	0.011	0.051
8 x 18	10	7,600	Middle	0.160	0.011	0.171
8 x 18	15	5,050	Middle	0.359	0.011	0.370
12 x 31.5	5	76,700	Uniform	0.033	0.014	0.047
12 x 31.5	10	38,350	Uniform	0.133	0.014	0.147
12 x 31.5	20	19,175	Uniform	0.534	0.014	0.548
12 x 31.5	5	38,300	Middle	0.027	0.014	0.041
12 x 31.5	10	19,150	Middle	0.107	0.014	0.121
12 x 31.5	20	9,575	Middle	0.427	0.014	0.441
20 x 65	10	124,700	Uniform	0.080	0.019	0.099
20 x 65	20	62,350	Uniform	0.321	0.019	0.340
20 x 65	40	31,175	Uniform	1.281	0.019	1.300
20 x 65	10	62,400	Middle	0.064	0.019	0.083
20 x 65	20	31,200	Middle	0.256	0.019	0.275
20 x 65	40	15,600	Middle	1.024	0.019	1.043

Notation: Δf = deflection due to flexure
Δs = deflection due to shear
$\Delta f + \Delta s$ = total deflection.

Hudson, in his book previously quoted, illustrates by example the more exact method of using actual moments of inertia as found at different sections. For a light plate-girder center-bearing drawbridge with girders of 72-in. web plate 138 ft. long with each flange of 2 angles and 3 cover plates, he finds the moment at the center support 15 per cent greater than that obtained by the ordinary method of using a constant moment of inertia. For a heavy plate-girder center-bearing drawbridge with girders of 101-in. web plate 159 ft. long with each flange of 2 angles, 2 side flange plates and 4 cover plates, the moment is 11 per cent greater than that obtained by the ordinary method.

Again, using the variable moment of inertia, for the shorter and lighter draw-span, the deflection of the end of the span due to the shearing stresses caused by uniform loading is about 4 per cent of that due to the flexural stresses from the same cause; the deflection of the end of the span due to the shear caused by a load at the end is about 3 per cent of that due to the flexural stresses from the same cause. The calculated moment over the center support obtained by a consideration of the flexural stresses alone is about 2.6 per cent greater than that obtained by taking into account the effect of the shearing stresses. For the longer and heavier draw-span, the consideration of the effect of the shearing stresses shows differences about twice as great, in each instance, as for the shorter and lighter structure.

A symposium, "The Deflection of a Beam of Non-Uniform Section," may be found in *Engineering News* of Sept. 14, 1907, p. 526.

(To be concluded.)

The Proletarian Mind

By P. B. McDonald
Assistant Professor of English, College of Engineering, New York University

SUCH keen observers as Lord Milner are saying that the world is to be ruled by the proletariat, the class without capital which has only its wages to depend on for a living. Labor is taking the control of things from the bourgeoisie, or middle-class capitalist, say the prophets, just as the middle class dispossessed the aristocracy; in the words of Macaulay, history is a record of the taking of power from one class by another, with the resistance of the enjoyers of privilege gradually overcome by the insistence of the new claimants. There is chance, of course, of a conservative reaction, such as occurred after the Napoleonic wars. Although the middle class is unorganized and slothful, it is not incapable of stubborn intrenchment, and has a tradition of producing great leaders. Most of the famous thinkers of the last several centuries have come from the middle class. Yet men of distinctly proletarian type of mind have lately risen to power, and it is worth while to speculate on the characteristics of such a mind as compared with the better-known middle-class and aristocratic minds.

The typical proletarian mind has not yet had a chance to assert itself, but approximations to it are evident in such public figures as Lloyd George, Gompers, and a host of minor labor leaders. These men, risen from the humblest environments, have not acquired the bourgeois point of view in rising, as many leaders of humble birth have done, but exemplify to a considerable degree the hard-headed, persevering, intuitive mind of the proletariat. Men of scant formal education, they do little reasoning of the kind that philosophers call rationalism, but, seeing conditions that appear to them wrong, they set about to remedy them with the means at their disposal. Too often their views are short, and they have not learned to disregard pin-pricking details, as have the rationalistic middle class and the leisurely and careless but very capable aristocracy. As yet the proletarian makes an uninspiring figure of a leader; he is unlovely and commonplace; witness the pictures of Ebert in Berlin, or the average labor-union committee—and looks count enormously!

Yet the labor leader of the better type has his points. He is terribly sincere; he takes a unified view of things; he has not the distressing fears of the bourgeois; and he is not a puritan. Trivial as the matter was, a recent cartoon in a radical magazine indicated Labor's con-

tempt for the priggish (as they see it) middle class; a well-dressed mother and little daughter were shown out walking, the child was pointing up and saying, "Oh, mamma, see the aeroplane," and the mother was saying, "How often have I told you not to point?" There is no denying that large sections of the middle class are caricatured by such a cartoon. Such sections are too apt to have a horror of committing social errors, a morbid regard for appearances, and a certain habit-formed aridity and insensitiveness. Though hard-working, according to their lights, they are wasteful and conventional and inclined to slave for Mrs. Grundy rather than for the good of the community.

The middle class is studious and conscientious, opportunistic and political, educated formally rather than practically—witness such public men as Roosevelt, Asquith, Clemenceau, Wilson. The aristocracy is far-seeing, talented, unhurried. Mr. Balfour is a type. They stand for a certain glamor and sense of fitness, but, as Editor Raymond of the British *Outlook* has pointed out, they believe that what oases of culture the world has would be lost if overwhelmed by the masses.

Much Yet to Learn

On the whole, the proletariat still has much to learn from the other two classes. They must learn not to antagonize all the rest of the nation. They should learn some economics and history, together with moderation and patience. Even though it is true that, like the Irish, the game has gone against them in the past, there is no sense in spoiling the world in which they too must live. They are likely to be farther ahead in the end by co-operating with the other classes than by drawing lines too tightly and excluding the more thoughtful kind of leadership. Rather than risk everything, part of which is not theirs, on a single doubtful issue, they should envisage the complexities of the world's problems and the need for men of various training and persuasions. It has been the aristocracy that was most inclined to encourage the development of talented individuals, and even the puritanical middle class has been more lenient than labor seems to be toward the exceptionally gifted intellectual—the type that does not fit into a factory conception of the world, yet a type from which, properly aided, much originality and invention is possible.

The best idea of what the proletarian mind is like is to be gained by listening to the conversation of men who work for wages and belong to a labor union. If the middle-class intellectual thinks he has nothing to learn from paying attention to such a conversation, he is sadly in error. He will find to his surprise that the wage-earner, though narrow-minded, to be sure (as are many capitalists), has a certain homely philosophy that is not unlike that of Abraham Lincoln's and that is convincing at times by its elements of irresistible truth. Though he is liable to be embittered and materialistic, the wage earner shows a rough sense of justice and a naive wish to balance things off into a practical compromise. It is only when he sees no better way out that he submits to the leadership of the radical element of his party. Lacking education and proper leadership, he is beginning to recognize some of the pit-falls that beset a reformer. He needs to understand better the problems that confront society, just as the other classes need to understand him .

The Urban Automobile Problem

IN a paper on "The Urban Auto Problem," delivered before the recent National Conference on City Planning at Cincinnati, Ernest P. Goodrich consulting engineer, New York City, finds that the study of traffic problems in congested areas leads to the following conclusions with reference to the planning of cities in their relation to the automobile problem:

(1) Streets should be designed with heavier pavements than at present.

(2) The elastic principle should be applied to the determination of the width of all thoroughfares, that streets wider than those now contemplated can be secured most economically by the use of several levels in the segregation of different kind of travel upon them, so that street car traffic may be carried in subways or in elevated structures and provisions be made for overhead sidewalks, and similar features.

(3) Special traffic studies should be made to determine the most advantageous location for cut-offs and detours (radial and circumferential streets) and whenever found economically feasible they should be introduced into existing systems, and as far as possible, planned for any future development.

(4) In connection with the handling of freight by automobile trucks, private rights of way should be arranged by the trucking interests to reach freight stations located near the centers of distribution.

(5) In connection with such special rights of way, in other places where traffic conditions warrant, separation of grades and crossings is to be considered.

(6) Of all intersections, study should be made of the economical possibility of enlargement by cutting off building corners and providing set-backs to the building line for a considerable distance of each side of each corner. In order to provide reservoir standing space for street traffic.

(7) These set-backs and cutoffs should be accompanied by set-backs of the curb and enlargement of curb radius.

(8) Where considerable enlargements are deemed necessary, consideration should be given to the possibility of introducing features at intersections around which traffic should be carried by the rotary principle.

(9) In cases of extremely heavy traffic, consideration should be given to the introduction of pairs of one-way streets in lieu of extra wide thoroughfares.

(10) A scheme of designing streets in threes should always be considered for those destined to carry heavy traffic, so that surface railways, commercial vehicles and other traffic may be cared for.

Depth of Water in Golden Gate

In a recent talk at the San Francisco Engineers' Club Colonel E. E. Winslow, Corps of Engineers, U. S. A., referred to interest which the U. S. Navy is taking in the possible dredging of the bar just outside the Golden Gate. The recently passed Rivers and Harbors Bill included an item for a preliminary survey and report on this work. The question at issue would be the dredging of a channel 1,000 to 1,500 ft. wide across the bar. The present minimum depth of water on the bar is 32 ft. and there has been no change in depth or location of the bar as far back as records go. The distance across the bar between 36-ft. contours, is about one-half a mile and between the 40-ft. contours about one mile. At present large boats do not cross the bar, deeper channels being on either side. Some years ago submerged rocks in the north channel were blasted down to a minimum depth of 40 ft. and with a knowledge of the channel it is possible to navigate a large vessel so that it is never in less than 50 ft. of water at lowest tide. The south channel has a minimum depth of 35 ft.

Concrete Consistency Measured by the Flow Table

New Apparatus Devised at Bureau of Standards Gives Accurate Measure of Flowability or Workability of Concrete

By G. M. Williams
Associate Engineer, U. S. Bureau of Standards, Washington, D. C.

"Flowability" is one of the several expressions sometimes used to describe the consistency or placeability of concrete. The quality of a concrete or mortar mixture which has to do with ease of placing may be referred to as "consistency," "mobility," "plasticity," "workability," or "flowability," and these words, although having perhaps slightly different meanings to many people, are generally synonymous as used.

The consistency or flowability which must be used in any case is dependent upon the nature of the work, type and arrangement of forms and reinforcing steel. For any given condition there is some minimum flowability which must be attained to result in good workmanship, and economy, and proper progress in the process of concreting. With given materials and proportions, flowability may be increased only by use of more mixing water which in turn will lower compressive strength. It is generally agreed that concretes must have the same consistency or flowability to be comparable, yet we have had no satisfactory method for measuring and controlling consistency. Consistency has usually been crudely estimated by eye or the judgment or feel of the operator, and as a result, test data obtained even in the same laboratory, must in many cases remain as small and isolated groups of tests, none of which bears any definite and known relation to the others. Studies made of the results of such tests are likely to lead to faulty conclusions since such concretes are not comparable.

The cylinder slump test and its modification, the cone slump, have been proposed and used for this purpose, and while they are far superior to the old method of "eye" and "feel," they fail fully to meet the requirements of such a test. One criticism of both is that the concrete seldom really slumps when the form is withdrawn, but the mass merely collapses into an unsymmetrical pile. In this respect the cone slump is less satisfactory than the cylinder, since when the former is employed the mass loses all lateral support as soon as the upward movement of the form is started and the tendency of the top to fall over is unresisted. A further criticism of both slump tests is that with different gradations of aggregates, or with different proportions of cement to aggregate, equal slumps do not result in concretes of equal flowabilities, so that the resulting concretes are not comparable. Investigations in the concrete laboratory of the Bureau of Standards

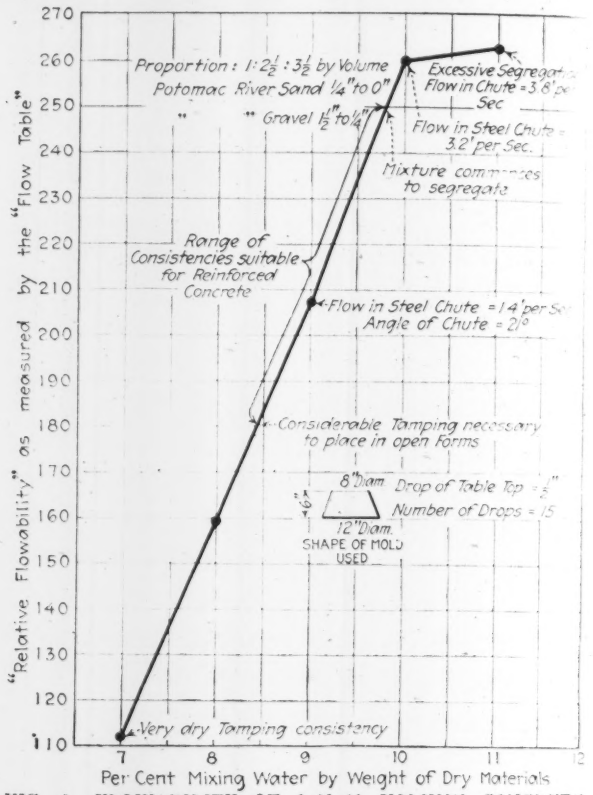

"Relative Flowability" as measured by the "Flow Table"
Per Cent Mixing Water by Weight of Dry Materials
Proportion: 1:2½:3½ by Volume
Potomac River Sand ¼" to 0"
" Gravel 1½" to ¼"
Excessive Segregation
Flow in Chute = 3.6' per Sec
Flow in Steel Chute = 3.2' per Sec.
Mixture commences to segregate
Range of Consistencies suitable for Reinforced Concrete
Flow in Steel Chute = 1.4' per Sec
Angle of Chute = 2°
Considerable Tamping necessary to place in open Forms
8" Diam
6"
12" Diam
Drop of Table Top = ½"
Number of Drops = 15
SHAPE OF MOLD USED
Very dry Tamping consistency

FIG. 2. FLOWABILITY OF 1:2½:3½ VOLUME CONCRETE AS MEASURED BY THE FLOW TABLE

Successive batches of concrete were prepared, each containing 1 per cent more mixing water than the preceding. Flowability is directly proportional to quantity of mixing water for any given mix within a practical and usable limit, and is also proportional to velocity of flow in a steel chute.

FIG. 1. FLOW TABLE USED IN CONCRETE LABORATORY OF BUREAU OF STANDARDS TO MEASURE CONCRETE CONSISTENCY

A mass of concrete is molded on the metal-covered table top in the shape of a frustum of a cone. The form is removed and the table top is raised and dropped a given number of times by means of a cam. The new diameter of the mass divided by the old, multiplied by 100, is called relative flowability. The 1:1½:3 concrete shown has a relative flowability of 170, about the driest consistency which can be generally used in reinforced-concrete work.

have emphasized that the control and the measurement of flowability is of fundamental importance, not only in laboratory testing of concrete but in the practical application of the results of such investigations to concreting practice in the field.

During the past year and a half a new form of consistency measuring apparatus, designated as the "flow-table" has been used in the concrete laboratory of the Bureau. The type first employed consisted of a piece of sheet steel about 30 in. square, supported at its center in a horizontal position. A mass of concrete was molded at the center, the mold withdrawn, and the edge of the plate struck a given number of weighted downward blows with a suitable hammer arrangement. The amount of spread of the mass was a measure of the flowability of the concrete.

The preceding type of apparatus gave very satisfactory results, but further experiment resulted in a table of the type shown in Fig. 1. This consists of a metal covered table top which can be raised vertically by means of a cam working at the end of a vertical post to which the top is attached. The height of drop can be adjusted by means of a bolt at the lower end of the shaft. A mass of concrete or mortar is molded at the center of the table in a sheet metal mold which has the shape of a hollow frustum of a cone. For aggregates up to 2 in. maximum size this cone has a height of 6 in. and upper and lower diameters of 8 in. and 12 in. For smaller aggregates when made up in small quantities, a cone having a height of 3 in and upper and lower diameters of 4 in. and 6 in. is used. The mass of concrete is tamped just sufficiently to completely fill the form, the form is withdrawn, and the table top is dropped 15 times through a distance of ½ in. The mass flattens and usually spreads concentrically. Two diameters at right angles to each other are measured, the long and the short if difference is apparent, by means of a self reading caliper which is so graduated that the sum of the two readings is the value for "flowability," which may also be calculated by dividing the new diameter by the old and multiplying by 100.

A typical curve showing the relation between the flowability of concrete as measured by the flow-table, and the quantity of mixing water used is shown in Fig. 2. Five separate batches of 1:2½:3½ volume proportion concrete were prepared with percentages of mixing water ranging from 7 to 11. Seven percent resulted in a concrete too dry for ordinary construction work. Nine percent of mixing water resulted in a concrete which flowed sluggishly in a steel chute which had an angle of 21°. Ten per cent furnished as wet and fluid concrete as is ever needed in practice. With 11 per cent a sloppy, segregating concrete difficult to properly sample was obtained. The added water in excess of 10 per cent resulted in practically no increase in flowability as measured by both the flow-table and the steel chute. This straight line relation between mixing water and flow as measured by the flow-table is characteristic of results obtained with other concretes, mortars, neat cement and lime pastes.

Fig. 3 shows graphically some results of tests in which the flow-table and the cone slump were used. A single batch of concrete was employed in this case for all determinations shown, additional quantities of mixing water being added for each ½ per cent increase. Due to loss of paste, absorption, etc., a slightly flatter curve was obtained with the flow-table than resulted for the individual batches of concrete included in Fig. 2. With the exception of the dip in the curve for 10 per cent mixing water, the values for the cone slump are of the usual order of accuracy obtained by either of the slump methods. It is seen that the change in values for the "cone" between 8½ per cent and 9 per cent, omitting the 5½ slump for 8½ per cent, is greater than that caused by the addition of all the mixing water beyond 9 per cent. A really desirable and necessary consistency for reinforced concrete work was not obtained until 9 per cent mixing water was used. It is characteristic of consistency measurements made by the slump methods that marked differences in slump result for differences in quantity of mixing water over a very narrow range only, and before practical working consistencies are obtained.

The advantages of the flow-table over the slump methods may be listed as follows:—

1. The flow table accurately measures flowability or consistency of a concrete, mortar, cement or lime pastes for all consistencies varying from dry masses which have only a slight tendency to flow or change their shape when acted upon by external forces, to those consistencies which are so fluid that the water and laitance will flow away from the coarse aggregate.

2. The relation between flowability and quantity of mixing water is practically a straight line relation for all workable and usable mixtures and consistencies.

3. The stiffening of a mass of concrete due to absorption of water by the aggregate, evaporation or setting of the cement is indicated by reduction of flow of the mass on the flow-table.

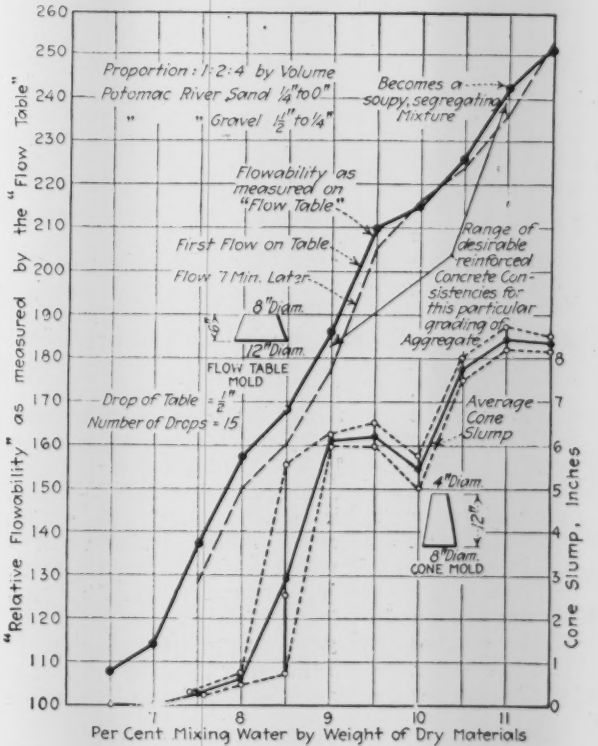

Proportion: 1:2:4 by Volume
Potomac River Sand ¼" to 0"
" " Gravel ½" to ¼"
Becomes a soupy, segregating Mixture
Flowability as measured on "Flow Table"
First Flow on Table
Flow 7 Min. Later
Range of desirable reinforced Concrete Consistencies for this particular grading of Aggregate
8" Diam.
½" Diam.
FLOW TABLE MOLD
Drop of Table = ½"
Number of Drops = 15
Average Cone Slump
4" Diam.
½"
8" Diam.
CONE MOLD
"Relative Flowability" as measured by the "Flow Table"
Cone Slump, Inches
Per Cent Mixing Water by Weight of Dry Materials

FIG. 3. COMPARISON OF CONSISTENCY MEASUREMENTS BY "CONE SLUMP" TEST AND BY FLOW TABLE

Increasing flowabilities were obtained by adding more water to the same batch of concrete.

The rapid stiffening due to absorption of water by the cement and the aggregate is so marked that it is found necessary to measure the flowability at some definite interval of time after the addition of the mixing water. This is especially necessary when working with concrete composed of aggregates varying widely in gradation. This time interval is that which would be required in practice to properly place the concrete in the forms.

While the apparatus shown in Fig. 1 is rather heavy and cumbersome for use in the field, the method of test is fully applicable to field conditions, and a machine of more recent design now used in the laboratory can easily be carried about by one man. So far as comparative tests have been made on various tables, the results indicate that flow for any given number of bumps and height of drop is independent of the weight of the top, so that in standardizing the apparatus consideration need be given only to (a) size and shape of molded specimen, (b) height of drop of the table top, and (c) number of drops of the table top.

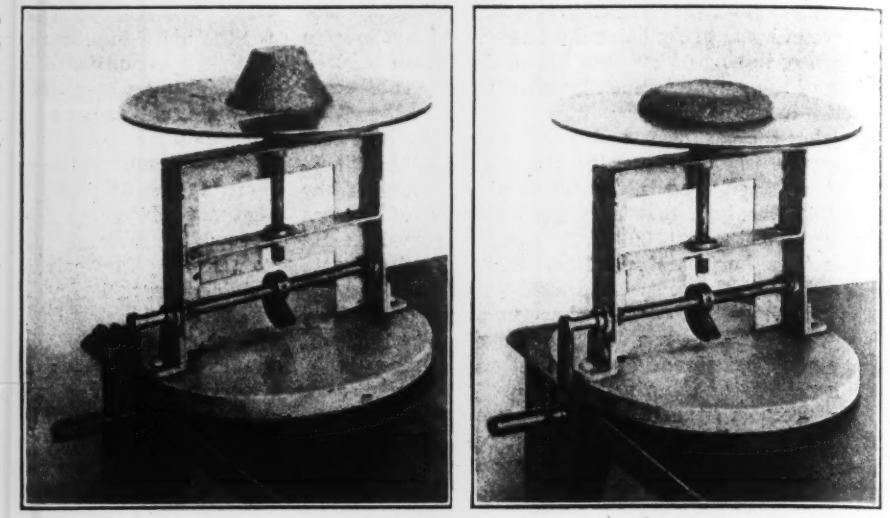


FIG. 4. FLOW TABLE USED IN BUREAU OF STANDARDS IN MEASURING CEMENT AND MORTAR CONSISTENCY

Views show the mass of standard sand mortar before and after being dropped twenty-five times. In this case the relative flowability was 126. A 1:3 standard sand mortar of normal consistency has a flowability of 110 as measured on this table.

Although the flow-table was first employed as a means of measuring consistency of concrete, its use has indicated that it may be of value in the control and measurement of several other properties involved in the tests of cement and concrete. These possibilities may be cited as follows:

1. Segregation. In working with dry concretes or concretes having a small ratio of cement to aggregate, or small quantity of fine aggregate, it has been noted that considerable of the coarse aggregate may be found outside of the well defined line of mortar which is considered as the flow line. The quantity of such coarse material appears to be a measure of the harshness or tendency to segregate, and such observations will permit of determination in the laboratory of the ease of working in the field of different combinations of aggregates whose flowabilities are the same.

2. Time of Set. The rate of hardening of mortar or concrete from the time mixing water is added is measured by "flow" of separate specimens on the table at intervals. A practical application was the determination of the rate of hardening of two mortar floor toppings, one containing an accelerator, on actual construction work. The mortar containing the accelerator was finished in one-half of the time required for the other, and the rate of hardening as measured on the flow-table was twice as fast for the former.

3. Normal Consistency. The apparatus shown in Fig. 4 has been in use in the cement testing laboratory of the bureau for checking determinations of the quantity of mixing water required for normal consistency of neat cement and standard sand mortars. Results so far obtained indicate the method to be more accurate and consistent than determinations by the "ball method" or the Vicat needle.

4. Selection of Concretes for Field Use. The flow table furnishes a means of measuring and expressing the missing factor "flowability" which is needed to permit of predicting in advance the approximate strength values which may be obtained for any given proportions of cement and aggregate. The ranges of strength values which may be expected for any aggregate when used with varying cement content and for the extreme ranges of consistencies needed in practice can be determined by a series of tests. Knowing in advance the type of construction, experience will permit the minimum usable flowabilities to be estimated, and for any required strength values the necessary ratios of cement to aggregate may be selected. The selections may be checked by the results of field tests of concrete, and a few trials will indicate strength variations which may result for the degree of thoroughness of field inspection employed, and permit of proper allowances for unavoidable variations in cements, aggregates, and curing conditions, etc.

The foregoing description of the flow table and its method of use is given with the hope that those who are interested in the testing of concrete will give the method a trial. No doubt further tests under widely different conditions will point out modifications and changes in the method and apparatus which will increase its value, and any criticisms based upon its application under such conditions will be appreciated.

Curing Concrete in Silicate Baths

Experiments to determine the effect upon the strength and permeability of concrete due to curing at different periods of time in solution of magnesium fluosilicate and sodium silicate have just been completed by the Bureau of Standards. These tests, although of a preliminary nature and limited in extent, appear to indicate that rich concrete mixtures may be improved in strength by curing for certain periods in magnesium fluosilicate, but they are not made less permeable. Both 1:1:2 and 1:2:4 proportions were improved in strength and made slightly less absorptive by curing in sodium silicate solutions.

New York To Build Steamship Piers on Staten Island

Twelve Piers About 1,100 Ft. Long and From 125 to 209 Ft. Wide With 300 Ft. Slips Have One or Two Story Sheds—Type of Pier and Shed Varied to Suit Lessees

NEW YORK CITY has just started the largest steamship pier project in its history in a part of the city hitherto ignored in municipal harbor development, that is Staten Island. Contracts have just been signed for the construction there of twelve new piers varying in length from 1,000 to 1,160 ft. and in width from 125 to 209 ft., with uniform 300-ft. slips. In accordance with the present practice of the Board of Estimate of the city, the money for the project was not appropriated until leases had been executed for the use of the piers, and accordingly the designs of the several piers differ considerably to meet the wishes of their respective lessees. Structurally, however, the design is uniform and in accordance with established practice in the City of New York.

Extending along the Staten Island shore for about a mile and a quarter between Tompkinsville and Clifton, these piers are located just inside the Narrows and face the Bay Ridge district of Brooklyn. In undertaking this improvement the city is practically transferring its past activities to the New Jersey side of the harbor, for while the Borough of Richmond is a political subdivision of the City and State of New York, physically it is close to and a parcel of the main land of the State of New Jersey. The Boroughs of Manhattan and Brooklyn, where the city's port activities have centered in the past, have an island location separated from the main land by the North and East Rivers, and this debars them from direct rail connection with the trunk lines of the continent, except in a roundabout way. The new Staten Island piers are located on the Baltimore & Ohio R.R., which at the six different points marked on the accompanying map of New York and vicinity connects with all the trunk lines terminating on the New Jersey side of the River, the Pennsylvania, the Philadelphia and Reading, the Central of New Jersey, the Erie, the Delaware & Lackawanna, the Lehigh Valley, and the West Shore thus affording direct rail connection with every part of the continent. At present the two tracks of the Baltimore & Ohio R.R. parallel the shore just back of the bulkhead line of the new piers but plans are being formulated in conference between the representatives of the railways and the Dock Department for the development of a proper track layout behind the piers as well as for enlarged yard and connecting facilities in the railway approaches.

The matter of improving the Stapleton waterfront first came up in 1918, when it became evident that the commerce of the port required a large increase of its wharfage facilities. The question at first arose as to whether the steamship companies would consent to lease piers so far away from the heart of New York City, or rather the Borough of Manhattan, where particularly the passenger lines have always had docking facilities close to the hotel and shopping districts. It was feared that the distance from Richmond Borough to this district—about 12 miles—would mitigate against the rental of any piers for ocean-going lines. However, this proved to be no obstacle, and the conditions laid down by the Sinking Fund Commission that leases be executed with prospective lessees for every pier to bring the city an income of 7½ per cent on the total cost of the improvement was readily met. For 11 out of the 12 piers the city before a single pile is driven holds properly secured leases, which in the course of 30 years will amortise every dollar expended by the city on this whole develop-

MAP OF NEW YORK HARBOR SHOWING RAIL CONNECTIONS TO NEW STATEN ISLAND PIER DEVELOPMENT

ment. One of the piers is reserved as an open pier for public wharfage.

As the policy of the city is to have all leases executed before any action can be taken toward the realization of any proposed plan, it is necessary that the planning be done in accordance with the needs and desires of the lessees. The city then takes the attitude that since the lessees assume the financial responsibility for the whole enterprise, their views must be considered and their avowed needs suited. The judgment of lessees as to the needs for the proper and economic conduct of their business must be final.

The layout of the new piers is given in an accompanying drawing. The site which is being acquired by the city through condemnation proceedings lies between the existing piers of the American Dock Co. and the Pouch Terminal, both privately owned. There are 12 new piers, the details of which are stated in the table on p. 1051. It will be seen that these vary from 1,000 to 1,160 ft. in length, the variation being due to channel and shore line irregularities and from 125 to 209 ft. in width, though the slip width is consistently 300 ft. Eight of the piers are 125 ft. wide and are completely covered, except for string-piece space, with a one-story shed; two are 130 ft. wide completely covered with a two-story shed and two are 209 ft. wide with a middle two-story shed of 131 ft. width and a marginal railway space of 28 ft. on each side. On these latter two full mechanical equipment is to be installed for handling freight direct from the cars into the ships and vice versa.

Drawings herewith show the cross sections of a 125-ft. pier, a 130-ft. pier and a 209-ft. pier and represent the three types of construction adopted for a single-story shed, a double-story shed of standard design, and a double-story shed with complete mechanical freight handling equipment. The general design represents no novel features. It is the standard Dock Department pier with reinforced-concrete deck, finished with a 2-in. asphalt block for a wearing surface. The only departure from the regular design in the pier work is a simplification of the timber work wherever that was possible without sacrifice of strength, in order to reduce the labor costs. The contracts just let provide also for dredging sufficient to open 30 ft. depth to the 40-ft. channel.

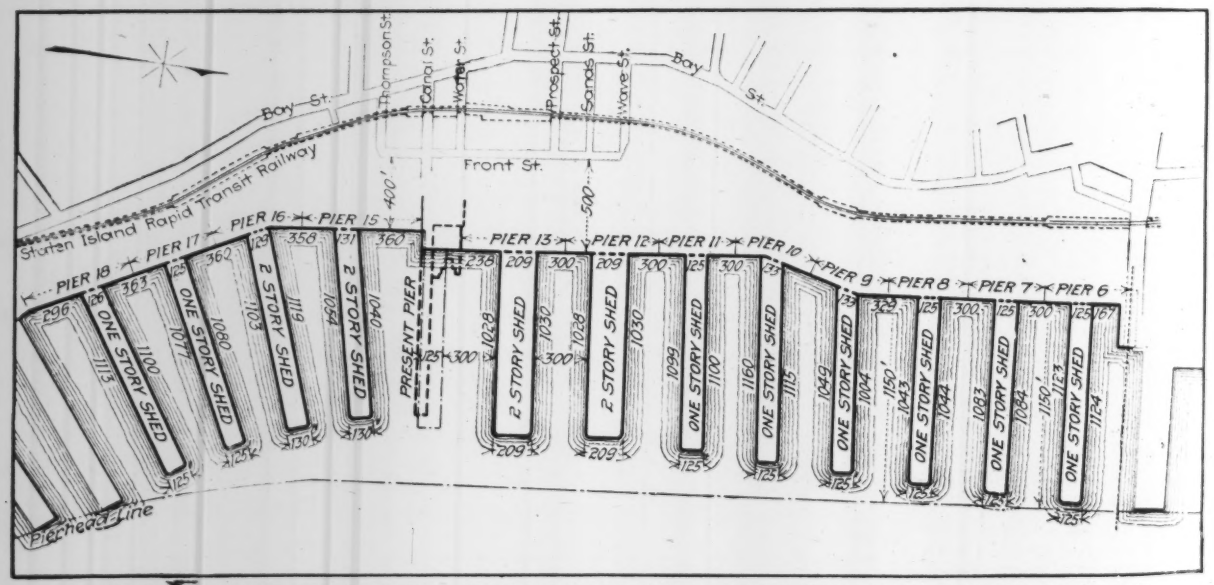
All piers contain proper structural provision for a double-track railroad inside the sheds, and the 209-ft. piers are provided with two tracks on each side of the shed, the floor of the shed being on the same level as the floor of the cars to facilitate the handling of freight.

The pier decks are designed for a live-load of 500 lb. per square foot, and the second floors of the sheds for a live-load of 400 lb. per square foot for the 209 ft. shed and for 350 lb. per square ft. for 130 ft. shed. The main floor is on the street level and is therefore approachable by tracks or drays from the street. The second floors are reached only by elevators and stairways under the present scheme but the topography is such that in future it will be possible to connect the floors with inland streets by viaduct over the marginal railway tracks.

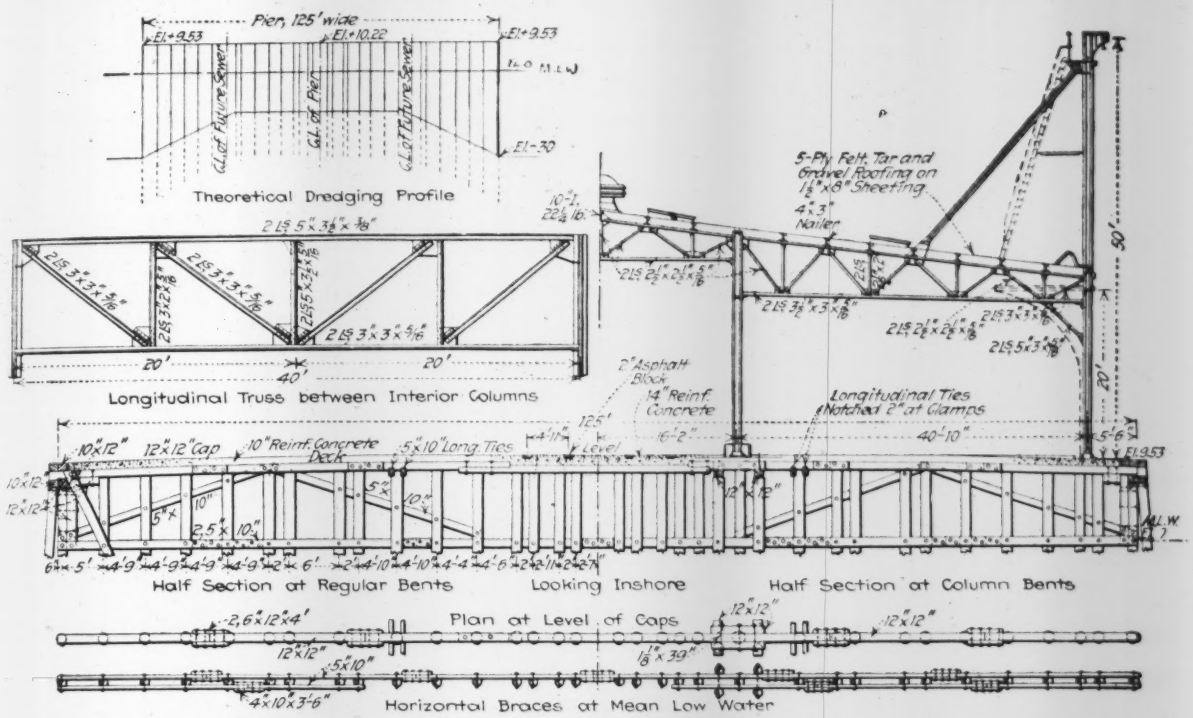
In a general way the sheds are of standard Dock Department design, very airy and light and as economcial as long experience and study of detail could make them. They are all equipped with sprinkler systems, ample water-supply for fire and ship watering purposes and ample electrical supply for light and power. As is common in the later New York piers doors are continuous around the pier sheds.

All sheds are equipped with the now familiar cargo girders, except the two 209-ft. piers, where the cargo girders do not apply on account of the complete crane equipment for handling cargo. The equipment for each of these two piers calls for seventeen 2½-ton traveling cranes, two 20-ton truck elevators and two 10-ton freight elevators. There is also provided a loading platform around the second floor of the shed.

Ever since the plans for this improvement have become public there has been criticism bestowed on them by quasi public bodies and individuals. Those charged with the duty of planning and bringing this work into reality have carefully considered every contrary point that was brought out, and state that no reason of weight for modifying the plans have been discovered.



GENERAL PLAN OF TWELVE NEW STATEN ISLAND SHIPPING PIERS BEING BUILT BY NEW YORK CITY

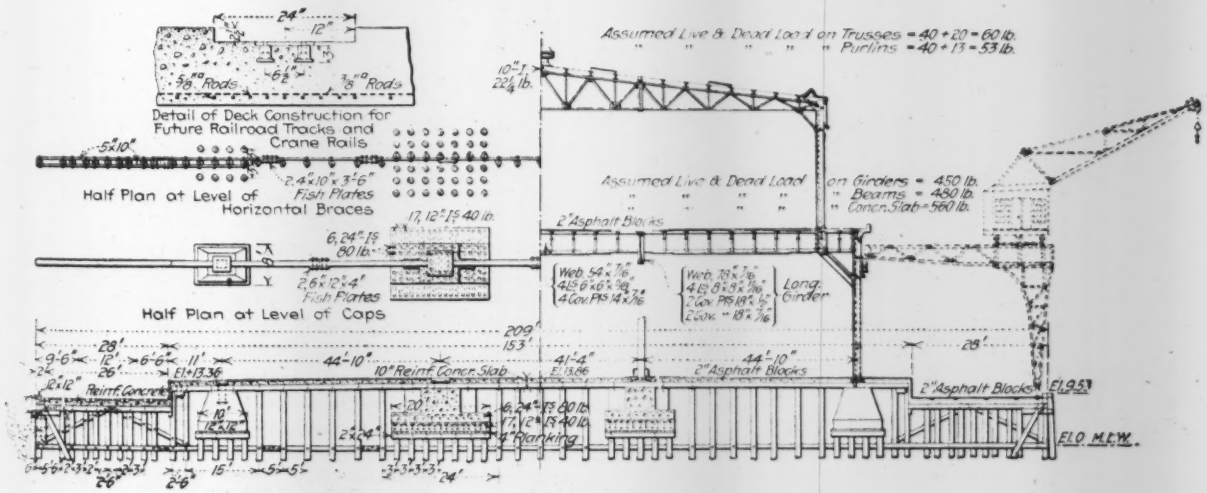


DETAILS OF 125-FT. PIER WITH ONE-STORY SHED

The points of criticism raised have been the narrowness of the pier structures, failure to provide track facilities on the piers and a lack of cargo-handling machinery. The arguments of the engineers and officials of the Department of Docks in defense of the present design and scheme may be stated as follows:

Engineers of other coastwise cities who studied the needs of their ports and those who had the duty and responsibility of planning for them are confronted with conditions widely different from those obtaining in the City of New York, and so have brought out developments of a different character. New York harbor by virtue of its insular location has sprung up and developed as a lighterage proposition. Up to about the year 1830 the shore along the North River was a series of beaches and while there were wharves, or rather landing platforms built over the beaches, small boats were used both to land and unload the trading vessels which were moved in the deeper water of the channel. Thus wharves becoming inconvenient to use, the citizens who had been given waterfront grants by the State began bulkheading their properties at the point where the water was of sufficient depth so that the small boats, and even the larger vessels, could moor at these bulkheads, thereby make the loading or unloading of them more convenient. This was the beginning of West St. and the portion of New York harbor adjacent to the lower end of Manhattan Island.

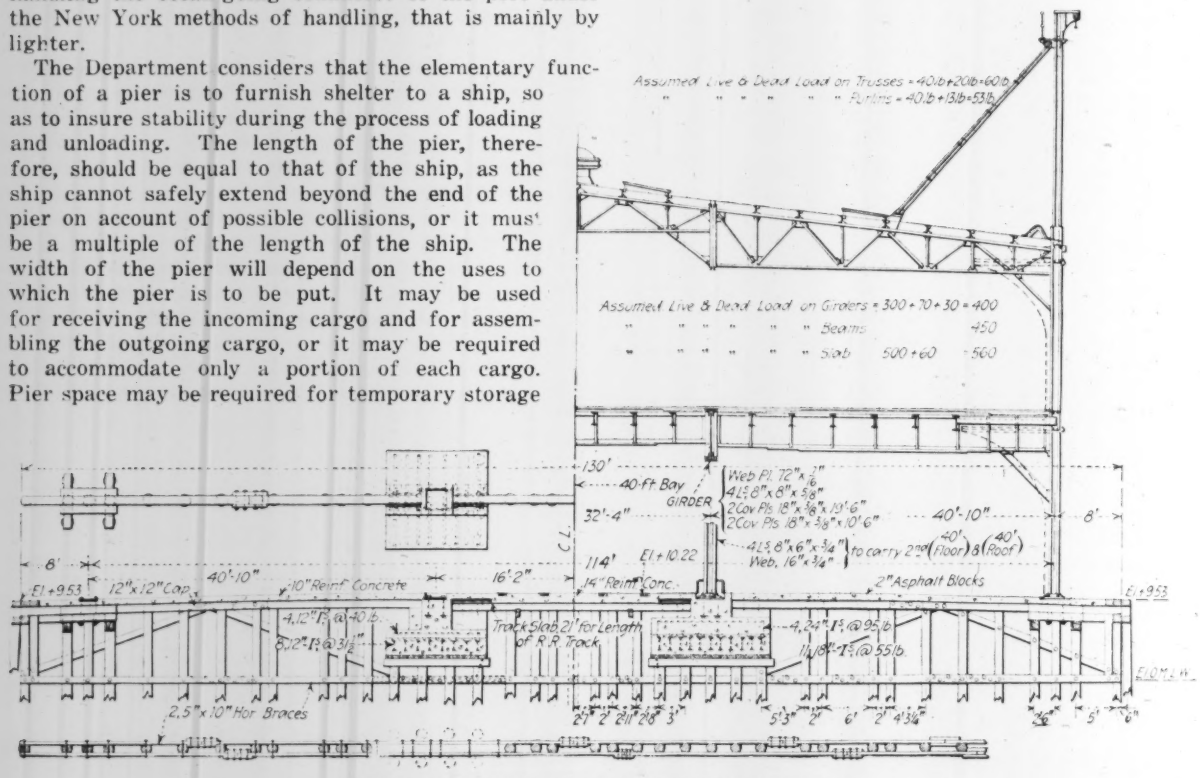
In about 1857 the Board of Aldermen discovered the possibilities of the new harbor and assumed control of


Detail of Deck Construction for Future Railroad Tracks and Crane Rails
Half Plan at Level of Horizontal Braces
Fish Plates
Half Plan at Level of Caps
Assumed Live & Dead Load on Trusses = 40+20 = 60 lb.
Purlins = 40+13 = 53 lb.
Assumed Live & Dead Load on Girders = 450 lb.
Beams = 480 lb.
Concn. Slab = 560 lb.
2" Asphalt Blocks
Long. Girder
10" Reinf. Concr. Slab
2" Asphalt Blocks
El.9.53
El.0 M.L.W.
Reinf. Concrete
4" Planking

DETAILS OF 209-FT. PIER WITH TWO-STORY SHED

its development, but it was not until after the Civil War that a systematic plan of development was laid out by Gen. George B. McClellan. This plan covered the North River from Vesey to Perry St. and the piers built under this plan, 40 or 60 ft. wide and with 100 to 150-ft. slips, proved adequate for many years. As the length of ocean-going vessels increased the piers were extended, but the widths of the slips remained unchanged. The result is that in many cases only one ship can be berthed in those narrow slips, and many years' experience in this harbor has shown that 125-ft. pier and 300-ft. slip is sufficient for all purposes in handling the ocean-going commerce of the port under the New York methods of handling, that is mainly by lighter.

The Department considers that the elementary function of a pier is to furnish shelter to a ship, so as to insure stability during the process of loading and unloading. The length of the pier, therefore, should be equal to that of the ship, as the ship cannot safely extend beyond the end of the pier on account of possible collisions, or it must be a multiple of the length of the ship. The width of the pier will depend on the uses to which the pier is to be put. It may be used for receiving the incoming cargo and for assembling the outgoing cargo, or it may be required to accommodate only a portion of each cargo. Pier space may be required for temporary storage


Assumed Live & Dead Load on Trusses = 40lb+20lb=60lb
" " " " " Purlins = 40lb+13lb=53lb
Assumed Live & Dead Load on Girders = 300+70+30=400
" " " " " " Beams 450
" " " " " " Slab 500+60 =560
130'
40-ft Bay GIRDER
Web Pl. 72"x 7/16"
4 L's 8"x8"x 5/8"
2 Cov Pls 18"x 5/8"x 19'6"
2 Cov Pls 18"x 3/8"x 10'6"
32'-4"
40'-10"
8'
4 L's 8"x6"x 3/4"
Web, 16"x 3/4"
to carry 2nd (Floor) & (Roof)
40'
40'
El+10.22
114'
El+9.53
12"x12" Cap
40'-10"
10" Reinf. Concrete
16'2"
14" Reinf. Conc.
2" Asphalt Blocks
4, 12" I's @ 40 lb
8, 12" I's @ 31½ lb
Track Slab 21' for Length of R.R. Track
4, 24" I's @ 95 lb
1 1/8" Rods @ 55 lb
2.5"x10" Hor. Braces
21' 2' 2 11' 2 8' 3'
5'3" 2' 6' 2' 4'3¼"
36' 5' 6"

DETAILS OF 130-FT. PIER WITH TWO-STORY SHED

of a whole cargo or of a portion thereof. The ship's cargo may be received on the pier by truck or rail, or alongside by lighter, barge or railroad float, and as these conditions of traffic will vary so the demand for pier space will vary in proportion, and no rule can be established, according to the Department, except what has been learned by years of costly experience.

When it comes to slip widths, a slip between two piers must accommodate two ships, and leave space for a lighter alongside of each and passage room for one lighter in the middle of the slip, with additional room for a coal barge between ships and pier.

As to cargo-handling equipment, the ship's crew should be put to work at the ship's winches while in port, and this is another reason why the steamship companies do not require extensive mechanical equipment on the piers.

The Department claims, however, that there is quite a difference of opinion among steamship men themselves as to what is the best harbor outfit in the way of piers and equipment, and this variation of opinion is nowhere better indicated than in the requirements put forward by the lessees for the new Staten Island piers. From the 209-ft. piers, equipped with double-deck sheds, double tracks on each side of the pier and an abundance of cranes and elevators to handle cargo mechanically to the one-story sheds with cargo masts and where in one instance the lessee even objected at the present time to having tracks constructed (although provision is made in the pier for such future tracks), there exists a wide difference, with the gap filled in with one-story sheds with tracks in the center and double-story sheds with double tracks on the first deck.

It is interesting to note that the International Mercantile Marine, one of the leading steamship firms in the world, has leased one of the piers with the one-story shed, railroad tracks to be omitted. When there is so much difference of opinion among practical steamship men, the Department considers it natural that students of the matter should be unable to agree.

A comparison of cost between the fully equipped 209-ft. pier and the one-story 125-ft. pier has been made. Assuming the cost of a 125-ft. pier complete, including dredging, but exclusive of property acquired, at 100 per cent, a 209-ft. pier will cost complete, including dredging and mechanical equipment, but exclusive of acquired property, 251 per cent, making a difference of 151 per cent, on which the lessee has to pay a rental of 7½ per cent a year to which must be added 7½ per cent on the cost of additional property required for the wider pier and the cost of maintaining and operating the equipment. As against this may be set forth the rapid loading of ships and the gain in earning power of same by the more rapid turn about.

DATA ON STATEN ISLAND PIER DEVELOPMENT FOR NEW YORK CITY

No.	Average Length, Ft.	Width, Ft.	Shed	Lessee
6	1,124	125	1-story	Green Star S.S. Co.
7	1,084	125	1-story	Open
8	1,044	125	1-story	Wesel-Duval Co.
9	1,026	125	1-story	Moore & McCormack
10	1,137	125	1-story	Raporel S.S. Line
11	1,100	125	1-story	International Mercantile Marine
12	1,030	209	2-story	Pan American Terminal & Dock Corp'n
13	1,030	209	2-story	
15	1,047	130	2-story	Union Transport Co.
16	1,110	130	2-story	
17	1,078	125	1-story	Nippon Yusen Kaisha
18	1,106	125	1-story	Compagnie Generale Transatlantique

The inauguration of this development is due to the efforts of Dock Commissioner Murray Hulbert. The plans were drawn, and the work will be carried out under the direction of T. F. Keller, Chief Engineer, assisted by J. J. Pemoff, Assistant Engineer in charge of the Bureau of Contract Supervision. The contracts already awarded are as follows:

Piers 6 to 11, both inclusive, to the Terry & Tench Co.; Piers 12 and 13 to Smith, Hauser & McIsaac, Inc.; Pier 15 to George B. Spearin, Inc.; Pier 16 to the Snare and Triest Co.; Pier 17 to Barth S. Cronin, Inc.; Pier 18 to the Phoenix Construction Co.; and the sheds on Piers 6 to 11, both inclusive, to the Bethlehem Bridge Co. The contract for the sheds on Piers 12, 13, 15, 16, 17 and 18 are now being advertised.

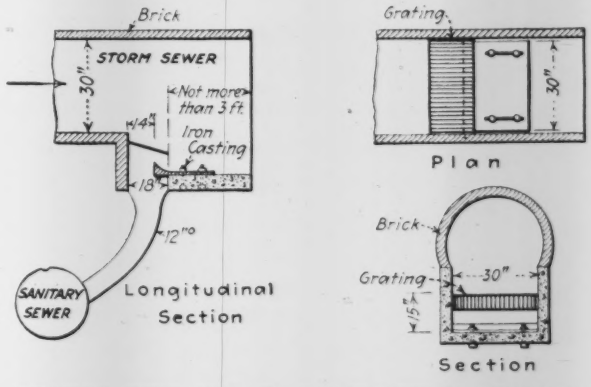
Traps and Leaping Weir Eliminate Odors From Waste in Sewer

STENCH and vapor from the untrapped street inlets of a storm sewer carrying industrial wastes, and from the stream into which the sewere discharges became so objectionable at Danville, Ill., last year as to demand prompt relief. This 36-in. brick sewer on North St. is not limited to storm water but carries hot brewery waste, hot water from an ice factory and sour milk from a creamery, these wastes making a peculiarly offensive combination. The remedy adopted for the streets was to equip all inlets with 12-in. vitrified pipe traps placed 24 to 36 in. below the surface, some corners requiring as many as eight traps. These cost complete about $25 per trap and so far there has been no trouble from clogging and freezing. The results have been entirely successful, although it was feared at first that trapping the inlets would serve only to drive the stench out at the numerous unknown sewer connections.

This sewer discharges into Stony Creek, a small stream which goes dry in summer, and at such times the discharge of the industrial wastes into the stagnant pools concentrated the stench to such an extent that residences near by were almost untenable. Storm flow could be discharged with impunity, but the problem was to care for the dry weather flow. A drop connection was made with a trunk sanitary sewer passing under the mouth of the storm sewer, and the bottom of the latter was cut away to permit the installation of a leaping weir, constructed as shown in the accompanying drawing.

There has been some trouble with the grid or screen. It was placed at an angle so steep as to be self-cleaning, but the dry weather flow trickled along the bars and into Stony Creek in sufficient quantity to renew the nuisance during hot weather. The angle is now reduced so that there is no trouble from trickling, but the grid gets clogged with leaves. It is thought that the difficulties would be overcome by returning the grid to its original slope and cutting the channel, so that any trickling moisture would drop into the sanitary sewer.

This leaping weir is designed to discharge all flow less than 30 gal. per minute into the sanitary sewer, and all higher flow into Stony Creek. It is proportioned in accordance with a formula for drop and span which was derived from experiments made at the University of Illinois by H. E. Babbitt, assistant professor of sanitary and municipal engineering, who described the Danville work at the recent annual meeting of the Illinois Society of Engineers. The work on the weir



LEAPING WEIR DIVERTS DRY-WEATHER FLOW OF STORM SWER

and the trapped inlets was done by the city sewer department under the direction of H. H. Edwards, city engineer of Danville, Ill.

Many Power Projects in California

As a result of complete stoppage of all hydro-electric development during the war and the rapid increase in the demand for power that followed, an unusual amount of power development is now under way in California. Thirteen steam and hydro-electric projects in that state scheduled for completion this year or next year will have an installed capacity totaling 260,500 kw. These plants are listed in the following table:

Power Developed by	Location of Plant	Date Set for Completion	Source of Energy	Installed Capacity, Kw.
San Joaquin Light & Power Corp	Bakersfield	June 1, 1920	Steam	12,500
San Joaquin Light & Power Corp	San Joaquin (Kerckhoff)	Oct. 1, 1920	Hydro	30,000
San Joaquin Light & Power Corp	McKittrick	Jan. 1, 1921	Steam	15,000
Southern California Edison Co	Big Creek (new unit)	Nov. 1, 1920	Hydro	16,500
Southern California Edison Co	Kern River No. 3	Nov. 1, 1920	Hydro	30,000
Southern California Edison Co	Long Beach	Mar. 1921	Steam	35,000
Southern California Edison Co	Big Creek No. 8	Apr. 1, 1921	.....	22,500
Pacific Gas & Electric Co	Oakland	Nov. 1, 1920	Steam	12,500
Pacific Gas & Electric Co	Pitt River	Jan. 1, 1921	Hydro	24,000
Los Angeles Gas & Electric Corp	Los Angeles	Jan. 1, 1921	Steam	10,000
Southern Sierras Power Co	Adams Plant	Jan. 1, 1921	Hydro	2,500
Great Western Power Co	Feather River (Caribou)	Mar., 1921	Hydro	40,000
Southern Sierras Power Co	Levining Creek	Oct., 1921	Hydro	10,000

Plank Surfacing Suggested for Secondary Highways

By George Kershaw

Hendersonville, North Carolina

As a transitory type of road construction on secondary systems, to serve a public demanding something better than sand-clay roads, though unable to invest in a so-called durable type of surfacing, I would suggest the use of planking, laid upon a well drained and well compacted subgrade. Particularly could such a type be used where lumber is plentiful and where county organizations could acquire their own mills and creosoting plants. Though I have had no personal experience with this type of road-building, as illustrated in the accompanying sketch, my ideas as to its method of construction would be as outlined in the following paragraphs:

A proper foundation of telford, or some other equally successful material for eliminating all soft or poorly drained portions of the subgrade, must be provided where found necessary. After subgrade has been brought to the required cross-section, trenches 8 in. wide and 4 in. deep, 3 ft. C. to C., shall be excavated at right angles to the axis of the road, and filled with 2½-in. crusher run stone. On the bases so formed, 4-in. x 6-in. sleepers are placed as shown in the drawing and the spaces between timbers then filled flush with their upper surfaces with 2½-in. crusher run stone. The whole is then to be rolled until thoroughly compacted, and low spots filled to give a smooth even surface. The 2-in. plank flooring is then laid with the axis of the road and fastened to the sleepers with lag screws, $\frac{5}{16}$ in. x 4 in., countersunk. The whole is then rolled to give perfect contact with the base.

Shoulders of 4-in. to 6-in. stone carried out to ditches as shown on the sketch must be provided to insure good drainage, bearing in mind that the wearing surface is not at all impervious to water.

County commissioners should acquire small tracts of timber land or cutting privileges adjacent to roads needing improvement. They should purchase their own sawmills, preferably of small portable type, also creosoting plants if it is deemed advisable to creosote timber. Small plants of this type are today logging and sawing small tracts at a contract price of $13 for M. f.b.m. Assuming the county could do as well and allowing $3 per M. for stumpage and $2 per M for haulage and creosoting sleepers, making a total of $20 per M. f.b.m., the cost would run about as follows:

WEARING COURSE

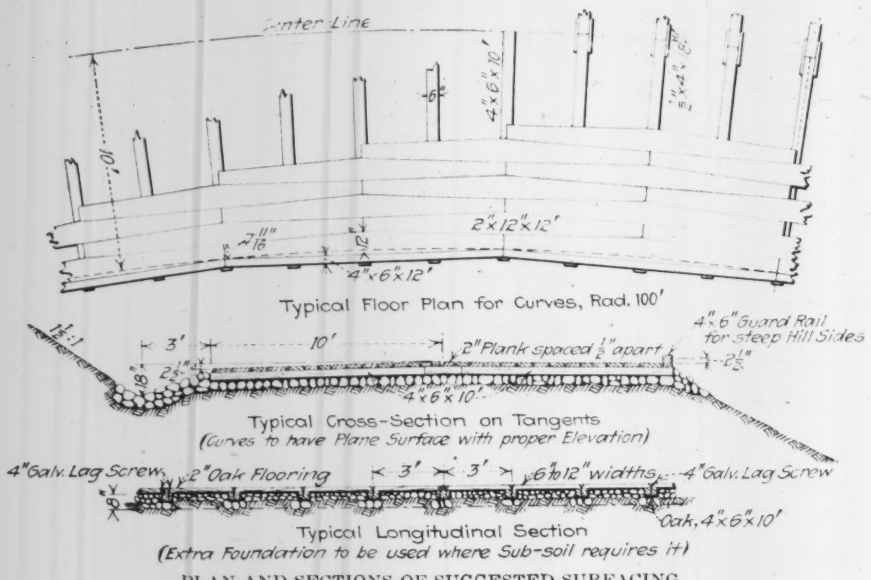
Sleepers—3520 pieces 4 in. x 6 in. x 9 ft.	63,360 f.b.m.
Planks—2 in., 8 in. to 12 in. widths, 6, 12 and 18-ft. lengths	190,080 f.b.m.
Total lumber	253,440 f.b.m.
At $20 per M at roadside	$5,068 80
Lag screws 95,000, 5-16 in. x 4 in.	1,710 00
Rough carpenter and unskilled labor for laying sleepers and flooring at $4 per M. f.b.m.	1,013 76
Total	$7,792 56

BASE

2½-in. crusher run broken stone laid 4 in. thick and rolled 1173 cu.yd. at $4 cu.yd. in place	$4,693 00
Total cost 18-ft. road, exclusive of excavation, culverts, foundations and incidentals (including overhead)	$12,485 56

Regarding the probable life of such a wearing surface we may reasonably expect 7 yr. of good service with light maintenance cost (Trautwine allows white oak crossties a life of 5 to 12 yr.), which could be prolonged to 12 yr. with an increased cost for renewals. After removal of wearing course and sleepers the base would still be available and should present, after filling spaces left by sleepers, a well compacted condition suitable for receiving a new wearing course of topeka mix, bituminous penetration or concrete.

To "Variable Designs for County Highway Systems" appearing in *Engineering News-Record* of Jan. 29, 1920, I would add this as a possibility. The method I have described seems practical both as to first cost and promised service and has some precedent in logging operations and bridge and dock flooring. I have had no personal experience with a road of this kind and hope to be able, through the columns of the *Engineering News-Record*, to hear from some one who has seen a similar type in service, or at least to elicit some discussion as to its probable usefulness



PLAN AND SECTIONS OF SUGGESTED SURFACING

All California Power in One Big System

After carrying out a plan recently agreed upon whereby transmission lines of the Pacific Gas and Electric Company and the San Joaquin Light and Power Corporation will be connected at Newman, Cal., there will be united in a single network, power lines from ninety-one electrical generating stations. This will include practically all important plants in the State of California. The total installed capacity in these stations is about 1,000,000 hp. Another interconnection expected some time this year will tie into this network the Truckee General Electric Co. This will bring in plants in the central region of California, east of the Sierra Nevada range, and Nevada near the interstate line.

Some Shortcomings of Public Improvement Minutes

By Frank B. Tucker
New York City

ENGINEERS who have to refer to the minutes of public improvement bodies for data essential to contemplated projects upon which they have to report are usually exasperated at the meagerness, inadequateness and incompleteness of such minutes both from an engineering and a business viewpoint, and will bear witness to the truth of the argument so often reiterated by *Engineering News-Record* that at least one member of all bodies that have to consider and pass upon engineering matters should be an engineer.

The writer has frequently to search the records of the city, towns and villages which were merged in 1898 to form the Borough of Queens, City of New York for data and facts regarding the city's title to streets within the limits of these onetime autonomous governments and for conclusive evidence proving that the original pavements upon streets of these former civil subdivisions were laid and paid for before consolidation.

The City of New York will not improve a street to which it is not sure that it has either a fee or an easement title, in fear lest it trespass upon private property and thereby jeopardize its right to assess the cost of the improvement upon the benefited property. The streets of these onetime governments that were paved and the cost thereof completely paid for before consolidation are entitled to repavement out of the general tax levy whenever, and as often, as necessary, regardless of the character or quality of the ante consolidation pavement. But where, however, it cannot be proved that a street was paved and the cost thereof paid for before consolidation the law classifies a new pavement thereon as an original pavement and assesses its cost upon the property deemed benefited thereby.

None of these old governments of Queens kept exemplary records. The officials of each suited their own conveniences and whims in the matter, as did also the officials of different administrations of the same government. In fact they seem to have left the matter of how the records should be kept pretty much to the clerk who kept them. The records of all of these governments, considered for their entire corporate existence, are woefully remiss in details, usually unwittingly but sometimes apparently wittingly.

Information Incomplete

Seldom do they contain the information one would look for had one of the officials been an engineer. Some streets acquired by condemnation or cession are so loosely described as to preclude their accurate re-establishment today. The sole reference to an important street improvement may be the bromide "On motion of Mr. Blank it was regularly moved and seconded that Blank Street be improved." What the limits, what the cost thereof, how defrayed, the minutes do not tell. And if we turn to ledgers and cash-books, in the few instances where such books have been preserved, we find little augumentative of the minutes.

The slipshod methods of these governments is well illustrated by an experience the writer had some time ago in an effort to prove that the pavements of a number of streets in one of the villages had been laid and paid for before consolidation, money being available for the repavement of these streets if the facts regarding their original pavement showed them to be entitled thereto.

The illustration typifies the loose accounting methods in vogue in the village, towns and city of Queens County prior to 1898, and is probably typical to a greater or less degree of public records as they are kept today throughout the country.

In the village in question a number of streets had a worn-out macadam pavement. That this pavement had been laid before consolidation, in fact the approximate date thereof, was quite easily determined by corroborative statements of disinterested old-time natives of the village and by the circumstantial evidence of the absence of any record of the pavement having been laid since consolidation. But to prove that the cost of the pavement had been paid for from money derived from (1) assessment of benefited property, (2) the general tax levy, or (3) a bond issue that had matured and been paid before consolidation, was quite a different matter.

The Case of Mr. Jones

The records of the village for the period at which old-timers stated the pavement had been laid showed many payments to a contractor, whom we shall call Jones, for street improvements, and the natural inference was that Mr. Jones was the contractor who had paved all or some of the streets in question and as such should be able to explain the fund from which he had been paid or at least to furnish a lead that would enable its determination. Accordingly the writer sought Mr. Jones. Inquiries disclosed the fact that he had completely obliterated himself from present day affairs of the village and was living in quiet seclusion on an unpretentious street thereof. On being interrogated as to whether he had paved the streets in question and as to whether he knew how the cost of the pavement had been defrayed he was exasperatingly taciturn and positively refused to put in affidavit form the meager information he begrudgingly gave on these matters.

He had laid the pavement but would not go on record as having done so. He explained his relation thereto by saying that he had only done what the president of the village had told him to do; that upon the completion of a job he had gone to the president and so informed him; that the president had then sent him to the village treasurer for his money, and that the treasurer had then and there paid him his money without any explanation.

The free and easy manner in which the president and treasurer of this village, according to Jones, spent the money intrusted to their care would have subjected the present day property owners upon the streets in question to assessment for the cost of the new, modern pavement that was laid upon their streets had not several substantial old-time property owners given affidavits satisfactory to the corporation counsel that one-third the cost of the original pavement of these streets had been paid for by an assessment upon the benefited property owners and the other two-thirds thereof out of the proceeds of a bond issue whose retirement before consolidation was a matter of record.

In the matter of streets acquired, widened or altered, every public body responsible therefor should be careful to see that its minutes state definitely the title acquired, whether easement or fee, and that a plan show-

ing the property acquired by courses and distances, starting from a fixed point that may reasonably be expected to be possible of identification by a later generation, is a part of its minutes.

Really, the statutes or other authority under which streets, parks and other public properties are acquired should specifically require that one member of the commission, board or what else should be an engineer or a surveyor, or at least it should make compulsory the employment by such bodies of a competent engineer or surveyor, for without the services of one of these disputes are pretty sure to arise at a later date as to the true bounds or location of the property acquired.

In the matter of the physical improvement of a street, the official record thereof should give the name of the street, and space may well be afforded for all the names by which the street may have been known, and if a new street its location should be given with reference to some old one; should give the limits between which the improvement is made; should give the nature of the improvement, and lastly should give the fund or funds out of which the cost of the improvement is met.

The records of the City of New York as kept in these matters today are not only complete but replete, though some difficulty is found by those not familiar with the regimen of procedure in running down the facts.

Street acquisition and physical improvements originate with the local boards of improvements, into a number of which the city is divided. Both acquisitions and physical improvements then go to the board of estimate and apportionment, the actual governing body of the city, for authorization. Following such authorization, acquisitions and physical improvements part company. The acquisition of a street being a legal matter goes to the courts for adjudication, the city being represented by its corporation counsel, for whom the president of the borough wherein the street lies makes all necessary maps and plans; the physical improvement of a street being an engineering matter goes to the president of the borough wherein it lies for performance. The courts apportion the awards and assessments that it makes in street acquisition cases and sends an accounting thereof directly to the comptroller for payment and collection; but the borough president has to certify the lump cost of a physical improvement to the board of assessors, whose duty it is to apportion it upon the property benefited and to then send it to the comptroller for collection. The court files its report in the matter of the acquisition of title to a street with the clerk of the county wherein the street is situated, but all the contractual papers in relation to a physical improvement of a street are in the custody of the comptroller.

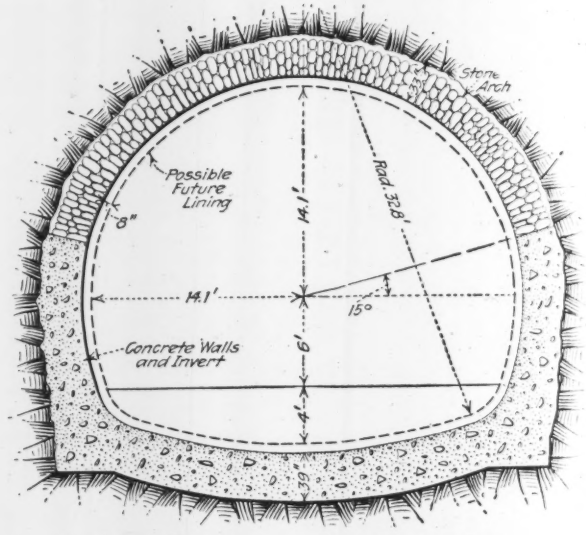
Cost of Water Filtration at Washington, D. C.

The cost of water filtration per 1,000,000 gal. at the Washington or District of Columbia filtration plant was $1.03 for the fiscal year 1918-19 for all labor and material coming under the classification "filter operation." Of this total 92c. was for labor and 11c. for material. Taking labor and material together, the $1.03 was divided, in costs, as follows: Office charges, 24 for filtration and 4 at the main office; laboratory, 22; scraping, 8; ejecting and washing, 10; smoothing, 1; resanding, 8; raking, 4; incidentals and repairs, 4; filter attendants, 12; pumping wash water, 6. E. D. Hardy is superintendent of filtration.

Restoration of Underground Flow Cut by Alpine Tunnel

Mountainside Wells Went Dry When Tunnel Tapped Large Water Pocket—Walled-Off Fissure Ends Connected by Pipes

PERMANENT pipe lines connect up the courses of the underground waters that flooded the tunnel headings of the four-mile Mont d'Or tunnel through the Alps on the Frasne-Vallorbe direct railway route between Paris and Switzerland. This tunnel was opened to traffic in 1915. Particulars of the difficulties encountered were given in *Engineering News* of Jan. 15, 1914, p. 131, while details of the control works have been published recently in the *Révue Générale des Chemins de Fer*, from which the following information is taken.



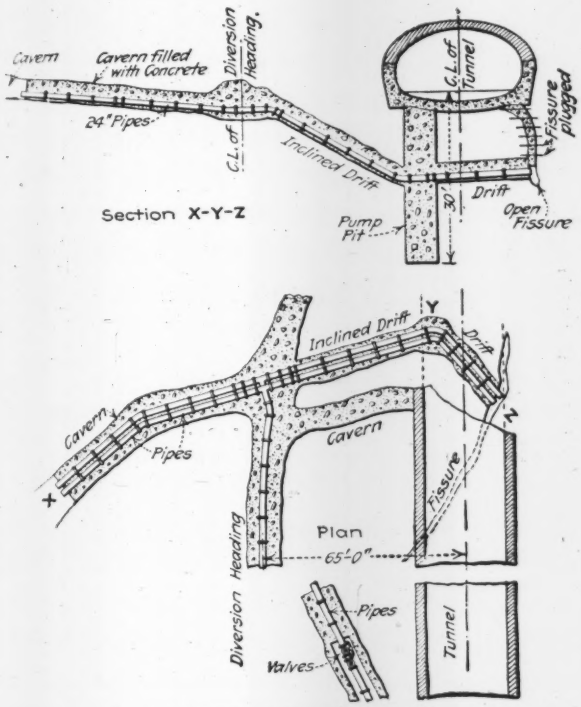
CROSS-SECTION OF MONT D'OR TUNNEL

A violent inrush of water occurred in December, 1912, in the heading from the Swiss end. The heading was finally sealed in advance of the leak with a concrete bulkhead in which were embedded pipes fitted with valves, after which the tunnel was completed to this point, with full section and lining. The water behind the bulkhead was then drawn off through the pipes, the bulkhead was removed and work on the abandoned heading was resumed. In April, 1913, another inrush of water occurred about 440 ft. beyond the first one and several wells on the French side of the mountain went dry. After some difficulty the bulkhead was rebuilt to close the heading a second time.

The next step was to start a diversion heading just below the bulkhead, swinging away from the axis of the tunnel and then running parallel with it on an ascending grade at a distance of about 65 ft. It was hoped in this way to intercept and divert the stream of water pouring into the tunnel heading. Opposite the point where this stream had been encountered, the diversion heading penetrated a large cavern or great fault in the rock, in which the underground waters flowed. This was explored for about 350 ft. and then plugged with a heavy mass of masonry on both sides of the heading. This diversion heading was then pushed forward, swinging around until it again struck the axis

the tunnel, beyond the place where the second flood- had occurred. Tunnel headings were then started both directions from this point, toward the French rtal and back toward the abandoned Swiss heading.

Investigation showed that the two points of entrance the water were in connection with each other and with the cavern. The second inrush had come through a issure having an opening nearly 90 ft. long, and 15 to 30 in. wide at about the subgrade level of the tunnel.



PIPE LINES RESTORE NATURAL WATER CHANNELS AROUND TUNNEL

Other fissures were discovered which would be under the walls and invert, all of which had to be sealed in order to make the tunnel stable and watertight. It was necessary also to re-establish the communication between the second stream of water and the cavern in order to restore the water supply of the wells on the French slopes. Solid masonry and grouting with cement were employed to close the opening at the first leak and the smaller fissures.

For the great fissure at the second leak it was necessary first to lower the water level by pumps, these being placed in a pit connected with the fissure by a horizontal gallery or drift, as shown above. The fissure was then enlarged sufficiently to admit a man, all loose and disintegrated rock being then removed and holes drilled for horizontal steel bars whose ends were thus embedded in the rock. Finally the fissure was filled to a depth of about 25 ft. with concrete reinforced by the transverse bars.

To enable the water under this plug to pass to the cavern and its system of channels or fissures, an inclined gallery was driven from the pump pit to the cavern, as shown. Two lines of 24-in. cast-iron pipe were then laid from the fissure to the main part of the open fault. A third pipe branching from these was laid in the diversion heading to a point near the first break, where it discharges into the central drain of the tunnel. Its outlet end is fitted with valves, so that the subterranean waters can be drawn off if necessary to facilitate repairs or the closing of minor leaks in the tunnel walls. These pipe lines are embedded in the concrete with which the headings and drifts were closed after the completion of the work.

For a length of about 250 ft. near the leaks the tunnel section was enlarged to permit a future 8-in. lining of cast-iron rings or concrete on the inside, if necessary to make the tunnel watertight. Here the stone arch and the concrete side walls are 32 in. thick, while the invert, subjected to upward pressure, is 39 in. thick. In its normal section this double-track tunnel is 28 ft. 3 in. wide, with a height of 24 ft. from invert to crown, as shown in the drawing, while it has a clear headway of 20 ft. above the rails.

Relief Sewers Recommended for Springfield, Mass.

IN a report recently submitted to Robert P. Marsh, superintendent of streets and engineering, Springfield, Mass., upon the sewerage and drainage of a portion of the City of Springfield, Metcalf & Eddy, consulting engineers, Boston, recommend relief sewers for a large part of the most densely built up section of the city, and submit a five-year program of construction designed to relieve at the end of that period the present deficiency in sewer capacity. For the initial estimates cost figures for 1909 were taken, as explained further on.

The city is sewered mainly on the combined system and several of the sewers have been extended back from the river considerably beyond the limits of the area naturally draining through them. The material increase in area thus made tributary together with the more complete development of the densely built up portions of the city, has resulted in frequent flooding of streets and some basements in parts of the city. It is found, too, that rainfalls of higher intensity than was supposed at the time the present sewers were planned occur in Springfield with some frequency. A 26-year record of a recording rain gage was available and the results which were analyzed in detail show rainfall frequency curves corresponding closely with those from New York City and materially higher than those for Boston.

A portion of the recommendations were submitted during 1919 in a progress report and the principal drains recommended at that time as most urgently required were built during that year. In order to base the cost estimates upon the same unit figures, all of which must be revised year by year before undertaking any part of the program, all the estimates submitted were based on prices prevalent in Springfield in 1909. No attempt was made to include the cost of cutting and restoring street pavement or of meeting special and unusual difficulties in particular localities where detailed local knowledge is necessary to an intelligent estimate. The estimates submitted amounted to $874,000 on the above basis, of which $36,000 was indicated for 1919 construction. The amount suggested for succeeding years ranged from $133,000 to $203,000. It is probable that on the present basis of prices, and including the local difficulties omitted from the estimates, the work recommended would cost from $1,200,000 to $1,500,000.

Lay Concrete Channel Lining With Large Traveling Form

In Improving Onondaga Creek at Syracuse Steel Framework Carrying Concrete Chute Car Moved Along Channel

CONCRETE lining in the improved and deepened channel of Onondaga Creek at Syracuse, N. Y., is expedited and advanced with little interruption by the use of special steel forms. These forms are of particular interest not only on account of their size and rigid construction but because of the special features in their design which permit rapid resetting and adjusting in position on tangent and curve. The facilities provided for the final grading of the side slopes and for the depositing and compacting of the concrete thereon are also of interest because of their originality and the greater progress made possible.

Onondaga Creek flows in a northerly direction about midway between the easterly and westerly boundaries of the city and has a drainage basin of about 113 square miles above Onondaga Lake, into which it discharges. The dry weather flow approaches 0.25 sec.-ft. per square mile as a minimum. The maximum recorded flood flow of 60 sec.-ft. per square mile occurred March

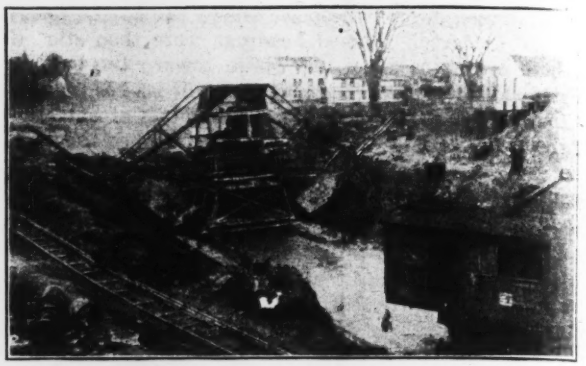
INVERT LAID PREPARATORY TO LINING

12, 1920. The stream is subject to rapid rise following storms and the steel forms were designed to permit the passage of flood water with the minimum of obstruction.

The deepening and improvement of Onondaga Creek through the central portion of the city was undertaken for the efficient operation of the intercepting sewer system which parallels the creek. This required a comparatively small concrete lined channel 30 ft. in width, 5 ft. depth, in the bed of the old stream. Certain features of this work were described in *Engineering News*, July 13, 1911, p. 38.

The improvement now under construction throughout the southern section of the city is designed for flood protection as well as for the operation of the sewer system. The contract for this work, awarded February, 1919, provides for extending the improvement a little more than two miles.

A typical cross-section of the concrete lining is shown herewith. The invert is 28 ft. wide, 2 ft. deep with bottom slopes toward the center of 1 on 7. Above the invert the side slopes are 1 on 1 for a height of 10 ft., making the inside top width of the channel 48 ft. The



CONCRETE LINING FORM IN ACTION

concrete invert is 8 in. thick and the side slopes 12 in. The contract includes about 6,700 lin.ft. of this cross-section.

Through one of the city parks, for a distance of about 1,300 lin.ft. the concrete side slopes are brought up for a height of only 3 ft. above the invert. Outside the concrete channel the earth banks slope up 1 on 10 for 6 ft. and then 1 on 3 until meeting the original ground surface. These earth banks are to be seeded and planted with shrubbery. Except during the spring run-off, it is only occasionally that the flow of the creek will exceed the capacity of this smaller concrete channel. This cross-section of channel through the park offers an excellent opportunity for landscape development and lessens the danger of accident to children playing in the vicinity.

The southernmost section of the city, where a greater hydraulic slope or grade is available, the width of the channel is reduced from 48 to 41 ft. This extends for a distance of about 2,500 lin.ft.

High water conditions prevail throughout the spring. It is rarely possible to divert the flow from the creek earlier than June, leaving only approximately five months during which construction may be carried on. For the purpose of draining the section of creek work under this contract, two concrete flumes were constructed. Each flume is about 1,200 ft. long, and the combined capacity is 300 sec.-ft. These flumes discharge into a large combined sewer and then into a section of the creek previously deepened and improved.

Excavation is made with a Monighan walking dragline excavator which travels backward upstream on the

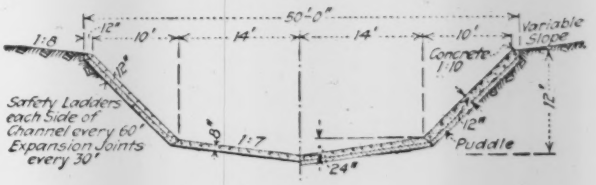
VIEW OF THE FINISHED CHANNEL

d bed of the unwatered creek in advance of the excavation. The material removed, which is mostly sand and gravel, is deposited in 3 cu.yd. dump cars running on a narrow-gage track along the top of the slope. A train of four to six cars hauled by a dinkey locomotive transports the excavated material to sections requiring embankment or to spoil banks. The invert is excavated closely to grade. The side slopes are cut slightly wider so that no trimming of the banks are required.

On completion of several hundred feet of excavation, placing of the concrete invert is begun near the end of the deepened channel and progresses downstream. The top surface of the concrete is brought to the required height by means of grade boards; no forms are required except steel channels which are set accurately to line and grade at the outside edges of the invert. A small pump at the upstream end of the invert prevents ground water rising and flowing over the fresh concrete.

Details of the side-wall forms are shown clearly by the accompanying drawing and photographs. The form consists of five units, each 14 ft. long, mounted on double flanged wheels which travel on a 16-ft. gage track laid on the concrete invert. Each unit is made up of three rigid trusses spaced 6 ft. centers and substantially cross-braced. The steel face of the forms against which concrete is deposited are attached to arms which slide within the upper and lower chord members of the trusses. This arrangement permits the face forms to be moved horizontally for adjustment in the desired position. The movement and adjustment is controlled by three screw jacks at each end of each truss, insuring extreme rigidity when set in the desired position.

The form units, 14 ft. in length, when set in position on tangent stretches of the creek channel are spaced 4 ft. apart, the intervening space being filled with planks for which grooves are provided at the end of the face plates. On curves the planking is cut to fill the intervening space between the units, which are set a minimum distance of 12 in. apart at the top of the forms on the inside of the curves.



TYPICAL 48-FT. SECTION OF ONONDAGA CREEK

In setting the side-wall forms in position, the first operation is to carefully align the track midway between the two outside edges of the invert which has been accurately formed as above mentioned. The form units are then rolled forward, the face of the forms jacked out to the back line or earth face of the concrete side walls, the planking set between the form units and the intervening space between the face of the forms and the excavated bank filled with earth and compacted by puddling and tamping.

On completion of the refilling and compacting of the foundation for the side-wall concrete, the base forms are pulled horizontally away from the earth banks by the screw jacks a distance of about 17 in., which gives the required space of 12 in. perpendicular to the slope to be filled with concrete.

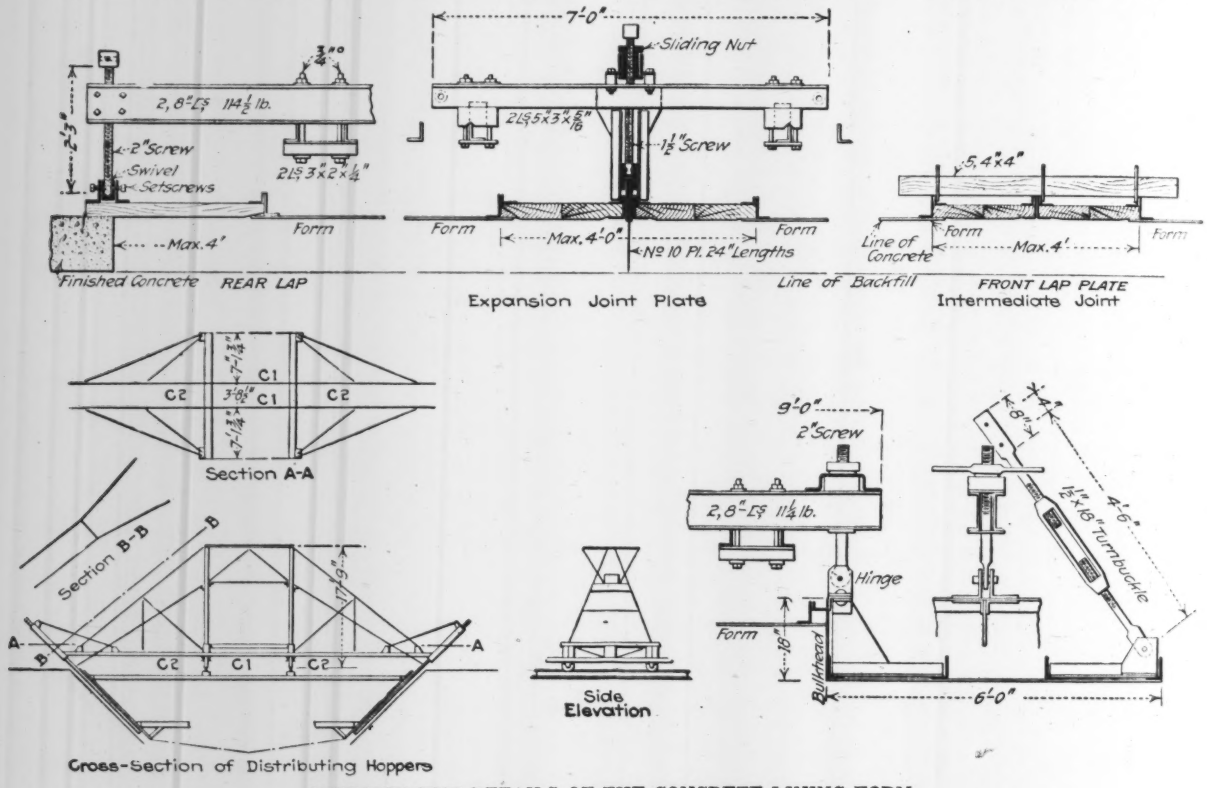
Concreting is carried on from a secondary traveler which runs on a track on top of the form trusses, as shown in the views and drawing. This is in effect a car with a hoisting engine and outriggers on both sides. Its interesting feature is the chute arrangement which is combined with a tamping device. It will be noted that the outriggers extend clear over to the side slopes and carry chutes from the hoppers on top of the car. These chutes run out to the side slopes and there empty into other chutes which are hung by rods from the main car frame and which slide down into the lining space. The bottom ends of these latter chutes are used as spades, in a way. Iu operation, the concrete, which is mixed at a central plant and brought to the machines in trains of narrow-gage cars, is lifted into the hoppers on top of the car and chuted down the main chutes into the side chutes, which are at the beginning of the operation at the bottom of the slope. These chutes then are joggled up and down by the hoist on the car and are raised as the concrete rises in the space to be filled. A special device is the hinged plates at the forward end of the forms. These can be made to die down as extensions of the regular side-slope forms, in which position they are placed during the puddling operation, and then can be pulled up to form

NEAR VIEW OF THE LINING FORM

stops for the end of the lining concreting. Another detail, shown in the drawings, provides a connection between the form and the old concrete already in place.

For the 41-ft. section, the middle panel of the form trusses are changed, as shown in the right-hand half of the cross-section of the forms.

Rapid progress is made with the device. The whole of a 90-ft, section can be puddled and concreted in a working day and the framework pulled ahead by its own power for the next 90-ft. stretch. Expansion joints are provided every 30 ft. by inserting a steel plate into the side slope according to the detail shown in one of the drawings.



IMPROVEMENT DETAILS OF THE CONCRETE LINING FORM

The work is being done for the Syracuse Intercepting Sewer Board under the direction of Glenn D. Holmes, chief engineer. The contractor, John Young of Syracuse, was the originator of the ideas embodied in the forms and prepared working drawings from which they were made by the Blaw-Knox Co. of Pittsburgh.

Lincoln Highway in New Jersey

In a recently published report of the chairman of the New Jersey Highway Commission, the assertion is made that the Lincoln Highway should receive the greatest consideration by the Highway Commission in completion and maintenance, so that it would be fitted to carry the heavy type of traffic required of "the heaviest traveled road in America." According to the present program, by the end of next year the entire 54 miles of the Lincoln Highway in New Jersey will be paved. During the present season the total amount spent by state and county for reconstruction of the highway is $1,382,572.

Causeway Being Built Near Singapore

THERE is now under construction a long and d causeway across the Strait of Johore between Joh and Singapore, in the Federated Malay States. Th structure, known as the Johore Causeway, consists a large bank of granite rubble 3,480 ft. long in wa averaging 47 ft. deep. It is to have a width on t of 60 ft., affording room for a double-line railway a a roadway for vehicular traffic of 26 ft. 6 in., protect on the outer side by a concrete parapet wall an divided from the railway by substantial fencing. The work when completed will close the Strait completely, so it is necessary to provide a passageway through the causeway in the way of a lock which will be required on account of tidal differences on either side of the causeway. The lock is 170 ft. between sills, 32 ft. wide, and has a depth of 10 ft. at low water. The roadway and railways are carried over the lock by a rolling lift bridge. The causeway will consist only of granite rubble of all sizes, no admixture of earth or soft materials being permitted. All the granite used in the construction, amounting to nearly 2,000,000 cu.yd., is to be obtained from the Island of Pulo Ubin, about 15 miles from the site. The stone in the underwater parts of the bank will be deposited from large barges and for the upper part is to be unloaded from trucks or cars running along the already completed portion of the bank or placed in position by floating cranes. The work is being carried out by the Federated Malay States Rys. by Topham, Jones & Railton, Ltd., to the design and under the supervision of Messrs. Coode, Matthews, Fitzmaurice and Wilson. The estimated cost is over £1,000,000 Sterling. It is described in *The Engineer*, London, April 30, 1920.

Reconstruction of Outlet End of Branch St. Sewer, St. Louis

Undermined and Washed Out Brick and Stone Sewer Replaced With Reinforced Concrete by Day Labor — Cost Data

By W. W. Horner
Chief Engineer, Sewers and Paving, St. Louis, Mo.

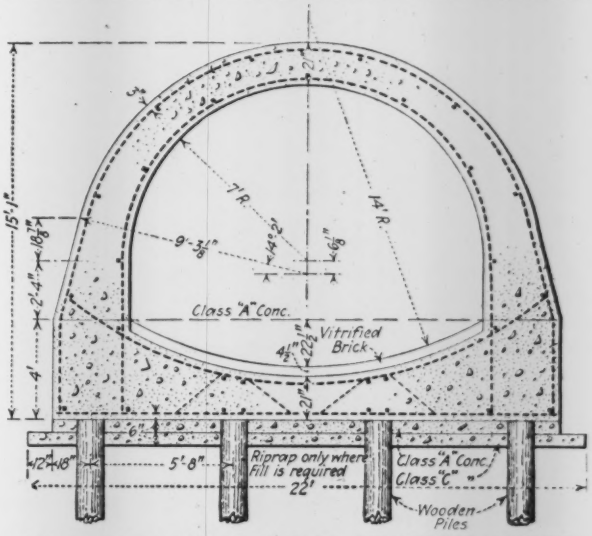
Reconstruction of the demolished river end of one of the large trunk sewers of St. Louis, Mo., was carried out during the past winter by city forces. Incidentally, the work fits into the reclamation of a considerable area of land needed by the city for dock and terminal facilities. This article describes the design and construction of the sewer and gives some cost data.

The Branch St. sewer is an old brick and stone conduit of a horse-shoe shape, some 12 ft. wide, built about 1870. It discharges into the Mississippi River on a mud flat. The undercutting of its mouth by the current of the Mississippi, and to a greater extent by its own outfall flow, has resulted in the gradual crumbling away of the end of the sewer. In the spring of 1919 it was decided to rebuild the broken portion of the outlet, and to extend the mouth of the sewer to the harbor line along the Mississippi River, requiring the construction of a length of about 330 ft. Some months later, after plans had been made, and equipment partly assembled for this construction, an extraordinary storm caused the collapse of 260 ft. more of the old sewer (see *Engineering News-Record*, Nov. 27-Dec. 4, p. 958) and necessitated construction of a total length of 595 ft. Plans for the new sewer called for a reinforced-concrete structure of the standard horse-shoe type, 14 ft. wide by 11 ft. high, supported on wood pile bents, each of four piles 40 to 50 ft. long, having an average penetration of about 25 ft. The bents were generally placed 5 ft. center to center, and were not capped, but the concrete invert of the sewer was made very heavy, and was specially reinforced over the pile heads.

The flow line of the proposed sewer is only slightly above the mean low water of the Mississippi, and winter stages at greater elevations are quite common. It was, therefore, considered inadvisable to attempt to let this work by contract, on account of the numerous contingencies involved, and the possibility of high water requiring the construction to extend beyond the first winter. The Department of the President, which has all engineering work in charge, decided to make arrangements for the use of labor forces employed by the Utilities Department in the construction of the adjacent North Market St. docks, and an arrangement was entered into to that end. This was particularly advantageous, as it permitted the transfer of labor from one project to another, and prevented the entire disorganization of the sewer forces during bad weather. A considerable amount of equipment used on dock construction was also available for the sewer work.

Pile Driving: The first work done at this site after the washout was the driving of a pile trestle by the Terminal Railway Co. of St. Louis. This was emergency work in order to restore switching service. The Terminal crew also drove the foundation piles for the sewer near this point, and the city's pile driver was set up on these piles. To hasten the work the city also rented a barge and set up a driver which was started at the outfall end of the new work. This outfit worked in to a point where the water was too shallow to float the barge. The third driver was then set up on the piles driven by the second outfit, and worked shoreward to meet the first. The penetration of the piles for the first 150 ft. at the river end averaged about 32 ft. below subgrade of the sewer, and for the remainder of the distance, about 24 ft. This work was not carried on continuously, as the river rose after about two weeks' work, submerging all pile driver equipment, and it was not until about Dec. 10 that the river was low enough to resume operations.

As the piling at the shore end had been completed before high water, it was decided to start the concrete work at that point, and to rush the work throughout the winter. It was, of course, necessary to flume the flow of the Branch St. sewer past the sewer construction. The best method of doing this was the subject of some debate. The construction superintendent at first proposed to build the flume the full size of the sewer, but from previous experience on this type of work the engineers were convinced that a heavy rain would carry out any structure that could be built, and, therefore, decided on a small flume about 4 x 4 ft. in section. A dam was built in the mouth



CROSS-SECTION OF RECONSTRUCTED SEWER OUTLET

of the old sewer, backing the water up about 4 ft., and the flume was carried along the line of the work a distance of about 50 ft., at which point it was diverted to one side, and the water carried in the new channel paralleling the sewer. This flume had about four times the capacity of the ordinary dry-weather flow, and successfully carried the flow of a number of moderate rains without interfering with construction.

After subsidence of the river it was found that the excavation around the pile caps would vary from 1 to 6 or 8 ft. and on account of the location of the gorge it was practically impossible to put in any machinery for handling it. Most of the excavation was done by hand, and as the ground was generally frozen, much of it had to be blasted. A small amount of material was washed out with water pressure. Excavation and pile cut off were carried along just ahead of the invert concrete.

Concrete: Concrete work was carried out through December, January and February under very unfavorable conditions. There were comparatively few days in this period when the air temperature was above freezing, and on several days the temperature was below ten. Both sand and gravel arriving on the work in car load lots were generally frozen, and much of it had to be picked out or melted. The cost for handling and unloading materials was therefore extremely high. After unloading, the materials froze on the stock piles, and artificial heating had to be resorted to. During the latter part of the work an extra boiler was used to supply hot water to the mixers. Two concrete plants were used to expedite the work. At the shore end, where the gorge was narrow, a mixing plant was set up on the bank and the concrete was chuted directly into the work. Near the river this was not practicable, and a tower and spouting equipment were set up. This equipment is shown in the accompanying view, the wooden chutes from the first plant appearing on the right of the photograph, and the mixer and tower in the distance. The first section of invert was concreted on Dec. 16 at the shore end, and the first section of arch on Dec. 31. Work from this plant was carried riverward about 250 ft. The first stretch of invert was concreted from the tower plant about the middle of January, and the last portion of the arch was finished on Feb. 17. To push the work, 110 ft. of arch forms were constructed of wood, which was more than double the amount normally used on work of this character. A traveling frame was used to brace the outside form of the arch concrete.

GENERAL VIEW OF SEWER CONSTRUCTION, SHOWING CONCRETE PLANT

Cost: The original estimate for this work was $103,000. The work was actually executed for a total cost of $73,500, but other work added in connection with the repair of a break in the sewer above the end, and the construction of a pile fender, brought the total expenditure to $85,420. This included all charges except the use of some equipment borrowed from other city departments. The work was carried out as a strictly union job, all forms, form moving, and form setting being done by carpenters at $1 an hour, all reinforcement being handled by iron workers, also at $1 an hour, and concrete by union concreters at about 70c. Common labor was paid 50 to 60 cents.

The concrete was a 1:2:4 mix, using a gravel aggregate. The cost of placing 2028 cu.yd. of concrete was about as follows:

For material delivered	$18,781
Labor in placing	11,312
Lumber for forms	2,476
Insurance	1,200
Equipment charge	788
Maintenance of equipment and tools	4,840
Coal	235
Miscellaneous labor	1,000
Total (about $13.50 per cubic yard)	$40,632

There should probably be an additional charge for use of borrowed plant, but the total unit cost would not be in excess of $14, which is considered extraordinarily good for work of this character in such a hazardous situation and under the extreme weather conditions that prevailed during almost the entire construction period.

The total cost of the sewer proper was as follows:

Concrete in place	$40,6
Reinforcement in place	10,0
Piling	15,2
Vitrified brick invert	2,2
Excavation	5,4
Total (about $123 per foot, including piling)	$73,5

The total cost per foot for the piling in place is about 70c., of which the cost of the piling was 18c. delivered, and 21c. for the actual handling and driving in the field.

This work was carried out under the direction of the Department of the President, under E. R. Kinsey, president of the Board of Public Service, through the Division of Sewers and Paving, of which the writer is chief engineer. Ernst Paffrath was resident engineer in charge, and was responsible for the direction of all engineering features. W. H. Smith was in charge of the labor forces of the Department of Public Utilities, of which J. A. Hooke was the director.

The work of filling the gorge around the structure of the sewer will be partly accomplished by silting from the Mississippi during the next high water season, and partly by dredging from the river. The actual filling of this land will provide about three acres of additional ground for the city's dock and terminal sites, which ground is valued at over $150,000. The completion of this sewer, however, is only one step toward the reclaiming of land in this vicinity.

The total area being made available by the construction of dock walls, the pile fenders and the filling of low ground is in excess of 25 acres, and there will thus be added to the city's river front holdings, property worth over a million dollars.

Various Methods of Locating Leaks in Water Mains

Electric Devices for Detecting Sound—Chemical Solutions—Charts of Water Hammer and Hydraulic Gradient

SOME of the methods employed in locating leaks in underground pipes were described at the recent meeting of the Illinois section of the American Water Works Association by Prof. H. E. Babbit, University of Illinois. A leak discovered by a surface indication is likely to be at some distance from that point and may be located by driving a rod at intervals back from the wet spot.

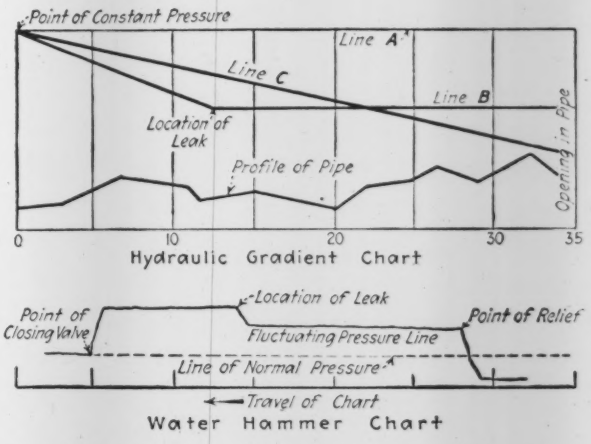
Sound Detectors: Leaks which give no surface indication are the most common and the use of sound is the principal method of detecting and locating them. Water escaping at high velocity through a small aperture will make more noise than when the aperture is large, while a free discharge will be more noisy than a submerged discharge. One of the simplest instruments used for locating leaks by sound is the aquaphone, which consists of a metal rod soldered to the center of a thin metal diaphragm as used in an ordinary telephone receiver. The point of the rod protrudes from the end of the receiver and is placed in contact with the pipe or fixture. If the pipe is buried, a rod may be driven down to make contact with it, the instrument being placed in contact with the rod. Considerable experience is necessary for the successful use of this instrument.

The detectaphone, the sonograph, the sonoscope, the geophone, etc., are somewhat similar instruments, the volume of sound in some of these being increased by an electrical amplifier placed in the line between the point of contact and the receiver. The receiver is similar to the ordinary telephone instrument with electric coil and magnet. The sound waves set up in the pipe are converted to electric waves in the amplifier and transmitted to the receiver much more loudly and clearly. All of these instruments require direct contact with the pipe, which is an undesirable feature, as the exact location of the leak may require excavations to be made, since the sounding rod is not always satisfactory.

In the Darley leak locator, direct contact with the pipe is not required. A delicate sound detector is set up on a small four-legged brass table which rests on the surface of the ground and is protected from air currents by placing the box containing the electric cells over it when in use. The vibrations set up in the detector are converted to electric waves which are transmitted to a specially sensitive telephone receiver. This instrument is so sensitive that it will detect the sound of a leak through the pavement and ground at the ordinary depths to which water pipes are buried, but it cannot be used in a high wind or where other noises may interfere.

Hydraulic Gradient: The characteristics of the hydraulic gradient are useful in the location of a leak, as shown in the diagram, the profile being that of a long pipe line or an isolated portion of a distribution system. It is suspected that a leak exists somewhere between stations 0 and 35. If the pipe line is shut off completely except at 0 and no leak exists, the gradient will lie along the line *A* and the pressures throughout the pipe line will indicate this height. If the pipe is opened and no leak exists the hydraulic gradient will be represented by line *C*, provided the diameter and other conditions are constant. If a leak exists and the pipe is closed the pressure at station 35 will be less than that at 0; the line of pressure will be horizontal up to the leak and will slope uniformly upwards from there to station 0, as in line *B*. These lines can be determined by locating two or more points and plotting their position on the chart, the leak being located at their intersection. This method was used with success by Professor Babbit in locating a leak in a five-mile pipe line at Nogent-en-Bassingny, France, during the war.

Water Hammer: The phenomenon of water hammer may be utilized. If a valve in a pipe line is closed



TWO METHODS OF LOCATING LEAKS IN WATER MAINS

quickly, a wave of high pressure travels from the closed valve up the pipe to a point of relief and a wave of low pressure then returns to the original starting point. The pressure at the valve fluctuates above and below normal until the disturbance has become stilled. Intermediate discharges between the valve and the point of relief will cause fluctuations in the pressure at the valve. The speed at which the wave travels is affected by the diameter and material of the pipe and other factors and varies between about 3,600 and 4,200 ft. per second. In locating a leak, its approximate location should be determined and the line of pipe isolated by the closing of valves so that it is connected to only one large service main, preferably much larger than the pipe in question. It may be necessary to shut off service connections or to apply the method when the services are not being used.

A quick-shutting valve is attached to a hydrant so located that the leak is between it and the water main, the distance from the hydrant to the connecting main along the pipe line being accurately determined. A delicate recording pressure gage is attached to another nozzle on the hydrant. In the pulsograph, a dial is revolved by clockwork, time is recorded by the vibrations of a tuning fork and variations in pressure are recorded by a delicate pressure gage. After the instruments are connected and the clock work is running, the valve is opened and is then suddenly closed while water is flowing, when the pressure line on the diagram will jump up and remain until a slightly relieving wave has returned from the point of the leak when it will drop a little. The pressure will then remain constant until the low pressure wave has returned from the

point of relief. The exact location of the leak is then determined by proportion from the diagram.

Chemicals: A method requiring the use of chemicals was suggested by T. J. Hoxie in the *Journal* of the New England Water Works Association, Vol. 27, p. 307. The leak is located within a certain section of pipe which is isolated, and all service connections are closed. A corporation cock is tapped into the main above the leak, to which is connected a 6- or 8-in. length of 2- or 3-in. pipe and a valve. Two or three pounds of caustic soda are inserted in the tube, the large valve is closed and the time of opening the corporation cock is recorded. Samples are collected at various points along the pipe and tested for alkalinity. As soon as alkalinity is found at any point it indicates that the leak is below that point because the flow created by the leak has carried the chemical down. Finally a point will be reached where the alkalinity does not appear. The indication is that the leak is between this point and the point at which it was last found. Water is withdrawn from the point at which the alkalinity has not appeared, the quantity drawn before alkalinity being carefully measured. This quantity divided by the volume per unit length of pipe will determine the distance to the leak.

Piston or Displacement: An ingenious method based on volumetric displacement was used for the location of a leak in a pipe line during the construction of the Field Museum in Chicago. A piston was made which fitted the inside of the pipe closely. A Y-branch was inserted in the pipe line, the piston was put in the pipe and a cable attached to it was passed through a packed joint in the plug closing the Y-branch. The water was then turned onto the pipe just sufficiently to keep the piston moving. When it had reached the leak it stopped, and the length of cable paid out measured the distance to the leak.

Leaks in Submerged Pipe: For locating a leak in a submerged pipe a quantity of bluing was dumped into the line and the appearance of color at the surface located the leak.

Wireless Pipe Locator: If the location of the pipe line itself is unknown it may be found by a wireless pipe locator. A circuit is made by connecting two points on the pipe line by an electric wire. A battery and vibrator are put in this circuit, the vibrator serving to interrupt current rapidly. An induction coil and a detecting coil connected to a telephone receiver are carried in the hand. When the induction coil held in a horizontal position is brought into the vibrating electric fields set up by the electric circuit through the pipe and wire a singing noise is heard in the telephone receiver. The volume of sound increases until directly over the pipe, when it ceases altogether. If the coil is then turned into a vertical position the loudest sound is heard.

Paris Coal Prices

Effective from March 16, 1920, a mandate issued by the préfet of the Sei. for the City of Paris fixed the prices of coal per ton as follows: anthracite, nut, 450 fr.; anthracite, large, 430 fr.; anthracite, small, 390 fr.; run of the mine, 400 fr.; briquets, 425 fr. Wood belonging to the municipality will be sold at a uniform price of 160 fr. a ton. Using the normal exchange rate for francs, nut anthracite costs $86.85 per ton. At present exchange it is about $26 a ton.

Is the Town an Efficient Unit for Any Highway Administration?

By George C. Diehl
Consulting Engineer Buffalo, New York

IN THE early days of the New England colonists, the town or township was adopted as the unit of highway taxation and administration. Since then innumerable changes have occurred, and traffic conditions of those days are no longer recognizable. Means of intercommunication have been developed so that now it is easier to cross a state in a motor vehicle than it used to be in many cases to travel between two places in the same town. Telephone, telegraph and rail facilities still further accentuate this change. In view of such a transformation, might it not be appropriate to ask: "Is the town or township the most efficient, or even the proper unit, for highway administration today?"

Without much argument it will be conceded that it is not the correct unit for *all* roads, as city streets, park drives, national and state highways and county roads never can or would have developed under town control. The query then arises, "Is the town or township an efficient unit for the administration of *any* highway?"

It is a fundamental of taxation that it should be spread as near as possible in proportion to benefits. With highway transportation as at present developed and with the certainty of the enormous future increase in the number of motor trucks on "country roads," it seems safe to assert that from cities to the remotest farm which sends produce to market, benefits accrue from the improvement of the roads. It also seems safe to say that a more durable and expensive type of road building must be adopted for the so-called "township road."

If the populous centers benefit from the improvement of farm to market roads, and if the advantages extend beyond the limits of the town, it must be agreed that the tax unit must be larger than the town. National and state highways are being cared for through a national and state unit of taxation, and the only remaining unit is the county. This is the logical and the equitable basis for taxation for secondary roads.

The amount required for highway purposes bears quite a definite relation to the amount of tonnage and this has increased so much more rapidly that the town cannot begin to afford the large sums which are required, but by increasing the unit to the county, then the large centers help carry the load.

In many counties the amount available, without an increase of tax rate would be 15 to 20 times the present highway fund, or to state this in another way, one-half the tax rate would produce 7 to 10 times the amounts now available. The increased fund would not only permit of more durable construction, but better tools and equipment could be purchased. (It is unnecessary to comment on the condition and kind of highway machinery in many towns.)

Highway work could be better systematized, work would not stop at town lines, improvements would be connected and county systems developed, petty town politics would cease to dictate highway policies, road foremen could be selected by reason of ability and assured of a fair salary and reasonably long tenure of office, with possibility of promotion in a good-sized, well-managed county road business.

All secondary town road work should be done under the general supervision of the state highway department. Such control is now in effect in many states. In Pennsylvania there are 8,000 town highway officials, in New York State 934 town superintendents and over 3,000 officials who determine road policies. It is at once apparent that the problem would be greatly simplified if the state highway department had to do with only 60 or 70 county units.

Many other arguments can be advanced both for and against this proposition, but the correct answer must come from practical men who have had to do with state, county and town road matters, and a discussion is urged of this important matter at all road gatherings.

Estimates for Reproduction Cost of Water Works

CHANGED conditions in the valuation of water-works due to the great increase in prices of materials under war conditions, together with probable future changes in such prices, were reviewed in a paper presented at the recent meeting of the Illinois section of the American Water Works Association by L. R. Howson, of Alvord & Burdick, consulting engineers, Chicago. From this paper the following information and tables have been taken.

TABLE I. AVERAGE PRICES FOR WATER-WORKS MATERIALS, 1910–1920

Materials	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
6-in. cast-iron pipe, f.o.b. Chicago	$26.92	$24.11	$26.17	$26.83	$24.21	$24.54	$31.25	$54.90	$57.85	$57.97
6-in. valves	12.50	12.50	12.50	12.50	12.50	12.50	16.50	19.50	21.00	22.50
2-nozzle hydrants	25.00	25.00	25.00	25.00	25.00	25.00	34.50	41.50	49.50	49.50
¾-in. meters	10.40	10.40	10.40	10.40	10.40	13.25	14.10	14.10	14.10	14.10
Cross compound pumps per M.G. cap.	3,000.00	2,700.00	2,500.00	2,500.00	2,500.00	2,500.00	3,300.00	7,500.00	7,500.00	7,500.00
Lumber, dealer's price	26.00	26.00	26.00	26.00	24.00	28.00	28.00	40.00	43.00	58.00
Cement (net)	1.25	1.25	1.25	1.25	1.15	1.15	1.43	1.78	2.00	2.00
Brick (Chicago)	6.50	6.50	6.50	6.50	6.50	7.00	7.00	9.00	12.00	14.00
Steel bars	.01¾	.01¾	.01¾	.021	.019	.019	.03¾	.064	.04¼	.04
Common labor in Central Illinois	.20	.20	.22	.22	.22	.22	.25	.28	.35	.40
Teams	.40	.40	.40	.40	.45	.50	.60	.70	.75	.80

TABLE II. COMPARATIVE PRE-WAR AND PRESENT PRODUCTION COST OF WATER-WORKS

Plant	Population Served	Tons of C.-I. Pipe Per 1000 Pop.	Per Cent Distributing System of Total Cost to Reproduce Pre-War	Costs of Reproduction — Pre-War — Cost of Pipe Per Ton	Pre-War	Present — Cost of Pipe Per Ton	Present	Excess Present Over Pre-War Cost %
A	92,000	245	58¾	$27.10	$3,700,000	$63.00	$6,400,000	73
B	8,500	217	79	29.00	280,000	57.05	503,000	80
C	10,000	286	61	28.00	264,000	55.00	444,000	68
D	12,000	294	77	28.00	394,000	59.50	689,000	75
E	25,000	170	66½	27.10	632,000	68.00	1,192,000	89
F	25,000	179	46	27.50	761,000	52.80	1,242,000	63

Note:—With pipe at present price ($66 Birmingham) percentages in last column would be raised to: 78 for A, 91 for B, 87 for C, 86 for D, 91 for E, 74 for F.

In appraising water-works properties the measure of value most commonly used is the estimated cost of reproduction. Prior to the war the basis for the estimate of future prices was the average of the prices which prevailed during, say, the preceding five-year period. Within the last five years, however, construction prices and conditions have changed, and the question arises as to where the reproduction cost of the future will probably lie. On several recent boards of arbitration, selected to fix the value of water-works properties, two estimated costs of reproduction have been made; one on a pre-war basis and the other on the basis of present day prices, the value being reasoned from these limiting estimates.

Few well-informed people will contend that pre-war prices will again prevail in our time, says Mr. Howson, so that a cost of reproduction using pre-war prices represents in all probability a minimum measure of the value of the property. Most appraisers are also of the opinion that the crest of prices has been nearly or quite reached, and that soon there will be a gradual recession to some new intermediate level. Accordingly, a reproduction estimate based on the present price basis represents approximately the maximum value of the property to those who hold this opinion.

Average prices of the more important water-works construction materials from 1910 to 1918 are shown in Table I. The results of cost of reproduction estimates made for six water-works properties during the past year on both the pre-war and the present price bases are shown in Table II. In the ordinary water-works property from 50 to 75 per cent of the total value lies in the distribution system, for which reason the fourth column of Table II shows the relative proportion of the distribution system cost to the entire plant cost, both based on pre-war units. Prices of materials for the distribution system have increased in relatively greater proportion than have those for other water-works materials, and accordingly the greater the proportion which the distribution system is of the entire property the greater will be the cost of reproduction at present prices as compared to pre-war prices.

It will be seen from this Table II that for properties in which approximately 50 and 75 per cent of the total value prior to the war was in the distribution system; the cost of reproduction at the present time would be approximately 75 per cent and 100 per cent, respectively, above the pre-war cost. Since the making of these estimates the costs of lumber, millwork and some other materials have risen, which would tend to increase these percentages slightly.

Dustproof State Health Laboratory Rooms

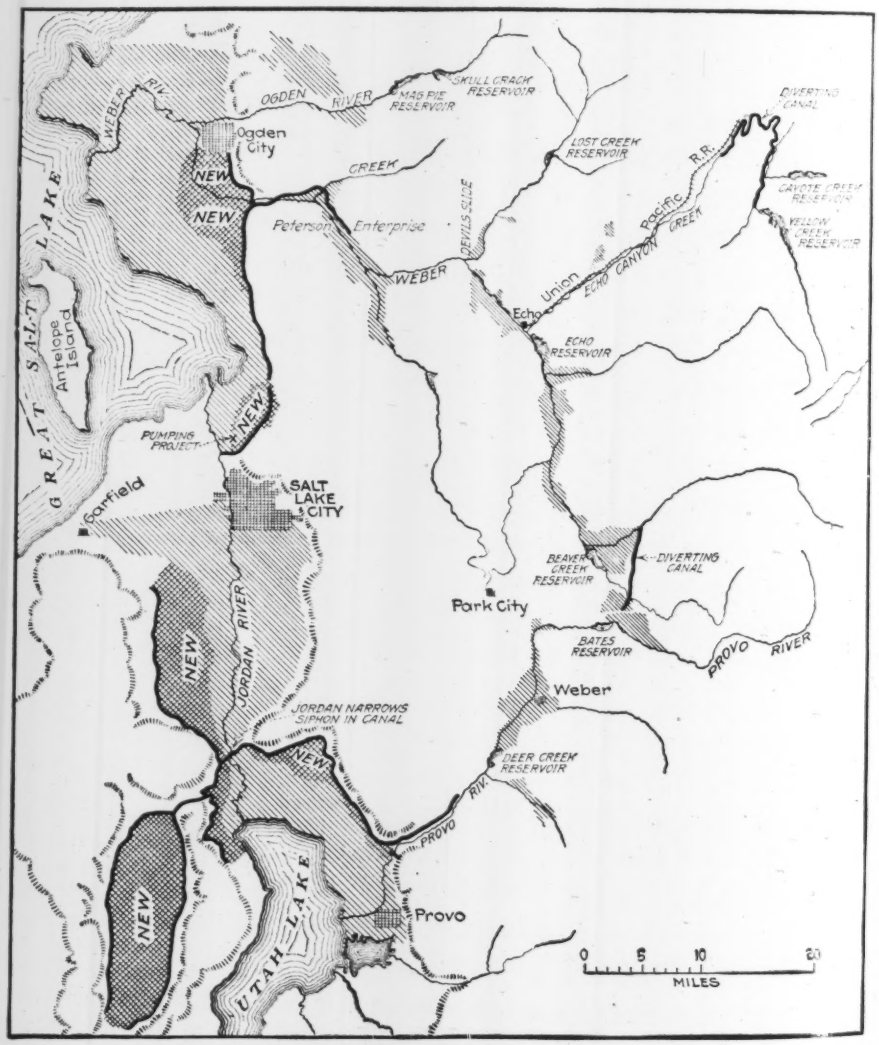
Dustproof rooms in the new laboratory building of the New York State Department of Health, according to the Department's *Health News* for December, 1919, were constructed as follows: "The walls of the rooms are of metal, forming frames for windows down to a point level with the table top in the room. Below this point they are constructed of expanded metal, plastered flush with the window frames. The doors are metal covered, suspended from above on rollers. In order to assure ventilation and at the same time reduce the amount of air contamination, space is left between the top of the side walls and the ceiling, this space being protected with a metal apron."

Plans for Ultimate Development of Oldest Irrigated Area

Utah Water Storage Association Proposes Method of Successive Interchanges of Water Over Three Water Sheds

ULTIMATELY 437,000 acres of land will be irrigated in the eight counties in the immediate vicinity of Salt Lake City, Utah. As with other areas of the West, Utah's future agricultural growth depends upon the storage of the flood waters now being wasted. Long ago appropriations of natural flow were exhausted for here, 72 years ago, irrigation was inaugurated in America by an Anglo-Saxon race. Spurred to action last year by the extreme shortage of water, the Utah Water Storage Association was formed to investigate and collect all possible data on the water supply, lands irrigable and ways and means of supplying the water to the lands within possible reach of water from the Weber, Jordan and Provo rivers. A. F. Parker, Ogden, is consulting engineer for the association, and from his recent report on tentative plans these notes are taken. The situation is so complicated locally that no attempt will be made here to indicate any but the largest features, whereby water is diverted from the headwaters of one stream to another in three or four successive steps. The principles on which the work was carried out, namely, the greatest benefit from a full development for the utmost advancement of the State, are applicable to other districts which are tied together topographically. The primary object of the association is to see that the development of the water resources of the State shall be considered and planned as a whole, and that any work done shall be done in accordance with and as a part of such plan. If each locality is allowed to develop a water supply in the easiest way for them, and with regard to their local needs only, it will be sure to result in a failure to make the best of possibilities. A beginning was made on the three river systems noted since they are the most important in the State. The relative water supplies available from the three streams in acre-feet are as follows: Weber River, 448,000; Provo River, 318,000; Ogden River, 229,000. It was concluded that the land which might be irrigated ultimately from these water sheds would be as follows: Under Weber River, 134,000 acres; under Provo and Jordon Rivers, 247,000 acres; under Ogden and lower Bear Rivers, which must be considered at the same time, 56,000 acres. From these data it is seen that the Weber River supply is the largest and supplies the greatest amount of water for irrigation. It is so situated that the waters of its upper reaches may be easily diverted into the Provo, and, with enough storage facilities for a full development, it is possible to make use of nearly all of the flood waters. So the local conditions demand that the Weber River be the first investigated since it is the larger and has first to supply the lands within its direct reach and then to furnish more or less water from its surplus to the Provo River, where there are ample areas of land awaiting it; in fact, more land than there is water from any practical source available.

Of the various feasible reservoirs the proposed 105-ft. Echo dam, costing $2,500,000 for a storage of 62,000 acre-feet would be the main dependence for storage on the Weber River system. The Yellow Creek flood-water reservoir is on a tributary of the Bear River.



ULTIMATE DEVELOPMENT OF IRRIGATED LANDS TRIBUTARY TO SALT LAKE CITY

diversion of it to the Weber via Echo Canyon Creek could require replacing the Bear River water from the Green River watershed, but this diversion would release Weber water at its source to the Provo. Extensive storage on the Provo River could probably be obtained most advantageously at the 115-ft. Deer Creek reservoir storing 88,000 acre-feet at a cost of $25.50 per acre-feet.

The areas marked "new" on the drawing are not all new and some of the other areas will be more fully covered than at present. Of the canals indicated the Provo system would be the most elaborate, involving a crossing of the Jordan Narrows with three miles of inverted siphon to reach the West Side lands. Rough estimates place the cost of the main 600-sec.-ft. canal at $3,200,000, including the siphon at nearly $1,000,000. The north and south branches are estimated at $529,000 additional. The Weber River high line would cost about $2,000,000, and an alternate low line, $1,300,000.

Necessity Demands Use of Untried Methods, Says British Road Engineer

BECAUSE, through force of circumstance, British roads have had little maintenance during the war, and because well known and tried maintenance materials are not obtainable in sufficient quantities, the British view has recently been expressed that experiments with untried materials or the employment of any other short-cut to temporary relief may be worth while, even though a percentage of the experiments produce failure. Such a stand is taken by H. Richardson, chief assistant city surveyor, Birmingham, in an article appearing in a recent issue of *The Surveyor*.

Mr. Richardson explains that so many roads have waited their turn for so long a time to be given maintenance and repair attention that the public will soon demand action on all highways. Not only has the shortage of labor, labor's general decreased efficiency and working hours and its increased remuneration greatly affected road construction, but there is a decided lack of road materials with which British road engineers are and have been acquainted. The demand in Birmingham for tarred materials, for instance, is far in excess of the supply and the output of firms further afield is snapped up by towns nearer than is Birmingham. The same situation is noted in the case of broken stone. Such a shortage of materials has existed that a keen but friendly rivalry in obtaining supplies has been produced among the various district surveyors.

Mr. Richardson believes it "possible considerably to shorten the time required if we are prepared to take a few risks in adopting, without waiting to apply the test of time and wear, any promising but comparatively untried materials or methods. Experiments need not be costly even if, as is not unlikely, a few failures are encountered, but in any case the experience gained will generally be well worth the time, trouble and cost." He does not advocate the adoption of cheap work or risky experiments on important roads subject to heavy traffic but as such roads, generally speaking, are in the minority it is his belief that many miles of secondary road in need of repair could afford to take risks. "Makeshifts are seldom cheap," says Mr. Richardson "and in road making should not usually be tolerated, but our post-war problem requires us to save time, and to encroach as little as possible on the available supplies of ordinary materials which are so urgently needed on more important roads."

It is upon the maintenance of suburban roads carrying only light traffic that Mr. Richardson would depart from established practice. Such roads, which form the great proportion of the British mileage, have good foundations and the only immediate necessity is surface restoration and that often along the center of the roads only. It was Mr. Richardson's suggestion that the speeding up in road work might be affected by the introduction, in addition to present practise, of new materials, new methods of preparation and new systems of laying and finishing. In the formation of a tarred-macadam mixture for surfacoing roads, he recommended clinker ash from refuse destructors, when broken and screened and freed of such pieces as would float upon the surface if the whole was thrown into a tank of water. Lacking destructor clinker good material he asserted was available in boiler ash, slag, old building materials, etc. Concerning new systems of laying and finishing Mr. Richardson indicated the possibility of carpeting instead of coating modern traffic roads, using ¼-in. to ½-in. slag, clinker, or any suitable material locally available. He predicted good use from a worn out waterbound macadam road if scarified, levelled along the shoulders and restored as to crown, and coated with from 1 in. to 1½ in. of tarred material of suitable grade. Another suggestion for restoration was that roads of a present high crown be scarified, crown reduced, and road rerolled, spreading excess material where it is needed. He also pointed to the possibility of using as coarse aggregate many waste materials such as broken bricks, old concrete, clinker ashes, gravel, broken pebbles, or any clean, hard material.

House Committee Recommends Increase for Road Material Investigation

In recommending an increase of $30,000 in the appropriation for road material investigations, the House Committee made the following statement:

In the suddenly expanding program of new road construction the highway engineer is facing the problem of road design without adequate data from which to form definite conclusions as to the types, the strength, or the materials which can be most economically used. Motor-driven traffic has now become the chief factor in determining the services that will be required of our highways, and the rapidity with which this character of traffic has developed has not permitted the gradual evolution of road types, as was the case with the prevailing road types developed to take care of the animal-drawn traffic. With the suddenly revolutionized methods of highway transportation, road surfaces which were adequate under former demands are failing to meet the greatly increased numbers and weights of motor vehicles. At the same time the cost of highway construction has materially increased. Highway construction, it is apparent, will be one of the greatest public activities which has ever been undertaken, and appropriations running into the hundreds of millions of dollars have already been made to finance that large program. The increased appropriation requested under this item will provide for conducting a comprehensive series of laboratory and field tests designed to give information which will permit of the selection of the right type and right design of road to economically serve the purpose for which intended. It is proposed to conduct a large number of such experiments, in co-operation with the various state highway departments. A part of the increase will also be needed to provide additional testing equipment and employ additional assistance to take care of the increased volume of routine testing and research work in the Washington laboratory.

Impressions Here and There

Engineering Affairs in Denver

DENVER'S civil engineering population is not busy, as formerly, on big hydro-electric, irrigation or railway projects for which this mountainous semi-arid region forms a natural setting. Expanding highway staffs are therefore being built up the more easily from these less active fields. Hydraulic developments have been strangled by legislation or lack of it, and business in irrigation has been curtailed for several years because Colorado was the storm center of so many ill-advised schemes. Here a decade ago broke the fury of the outraged Eastern investor whose money, too often in bonds, went to pay for surveys and preliminary investigations to learn whether or not the land was irrigable.

Irrigation these days is on a substantial basis, but the Standley Lake dam still remains in its mis-shappen condition as a testimonial to the persistent lack of confidence of those with money, although a comparatively small sum would repair the slides and make the dam useful to a 90-ft. height, 15 ft. below the original. There it stands, its huge caving cracks not easily discernible through a rank protecting overgrowth of weeds. Mutely it calls for an earth-moving force to mend it. Particularly urgent was the appeal last summer on account of the unprecedented drought, coupled with the cry of the world for farm products.

Drainage of irrigation projects recently has become an outlet for the engineer's endeavor. Much education of the layman owner still is required, but stern necessity and the example of good results already accomplished are driveng work, formerly done without technical supervision or preliminary investigation, into the engineering offices. A few civil engineers have taken on oil engineering and found it profitable. Railroad engineers, as such, have had hard sledding, for it has been difficult to persuade the railroad administration to look with favor even on maintenance expenditures almost absolutely essential to keep the roadbed factor of safety above one. As an example, on one road ordinary replacements of worn-out rails have been 6,000 tons of rails per year, but the administration could not see that more than 3,000 tons were necessary. One can hardly blame railroad engineers under these circumstances for becoming less optimistic than the members of this loyal, enthusiastic, hard-working, poorly-paid branch of the profession usually are.

With this condition in the regular fields it has not been so hard for highway officials to recruit staffs to carry out their rapidly increasing programs. Chances for advancement are greater in newer organizations. probably railroad experience is more nearly adaptable to highway work, but many irrigation engineers are finding places on road work. Earthwork is common to both. A road location is not unlike canal alignment, and in the intermountain country the highway programs have not yet advanced far beyond the grading stage. Eastern practice is relied upon where the comparatively few hard surfaces are applied. The irrigation chiefs are not complaining particularly about losing men since the salaries which it has been possible to pay have not been very lucrative. Federal engineers in particular have been hard hit because of the diminishing value of the dollar, but the *esprit de corps* in the Reclamation Service has held this organization together remarkably well so far, the men looking hopefully for better things to be provided by congressional appropriations.

Road Building

Probably the most potent factor in advancing a comprehensive road program in Colorado is the rapidly increasing tourist traffic. For years the state received the two- or three-day extra stop-off portion of the vacationist's time—and money. Now it is his destination. In 1915 31,000 people tarried in Denver a brief three or four hours, while in 1919 169,490 spent their whole vacation period of from two weeks to three months in Colorado. Their objective was the mountains at close range and that means good roads. With a jitney, a tent and a driver, all rentable in Denver, one may vary scenery, camping spot and fishing at will. To the demand for good roads from the local merchants is added that of the opulent farmer of the neighboring plains states coming in his own car, and of the train-weary Easterner seeking escape from excessive temperatures.

Colorado roads are good in those regions where suitable material lies along the roadside, but otherwise the state is extremely backward in providing funds for building a comprehensive system. The bulk of the money is spent by the counties, and those adjacent often have vastly different views as to the consideration their particular mileage of a through route is entitled to. Public opinion is focusing on this condition and the state system will get funds before long.

As to details the Mountain Parks drive, entirely within the disintegrated granite area, is a good road, but in the 12 mi. between Denver and the first hogbacks is a stretch of clay, most slippery after the frequent summer showers. Two or three sections of surfaced road now cross this clay barrier, but several more are needed.

Like Illinois, hard surfacing has been done all over the state in exasperatingly small sections. Material progress has been made, however, on a north and south "military" road just outside the first mountain range. More than $500,000 is being spent on a 64-mi. section north and south of Walsenberg which will permit all-the-year traffic from Denver into New Mexico. In an inspection trip over this road last August, J. E. Maloney, chief engineer of the State Highway Department, reported meeting cars from out of the state at the rate of 30 per hour.

Denver has a miniature federal department of public works, in a way, for here are located the construction headquarters of the Reclamation Service and a combined Federal-aid and Forestry district highway office. The engineer-appraiser for the Farm Loan Bureau is located in the recently completed postoffice, but apparently it is not large enough for all of the Federal offices, the Reclamation Service being in a private building and the road bureau in the old postoffice.

What W. H. Whistler is doing for the Farm Loan department resembles what many "invisible" engineers

attached to bond houses and financial institutions have been doing for years in appraising properties. Only he has the whole irrigation territory and must work wholesale, taking entire irrigation systems or whole watersheds, classifying and rating them according to the numerous factors which go to make up the values in property. Security and stability of structures, priority rights, drainage necessities, climate, soil fertility, crop possibilities, flood dangers, markets, transportation and class of colonization, are some of the subjects gone into in detail before an opinion is rendered as to the relative desirability of placing loans in that particular region. Since the loans are of the long-term class, and the banker must take into account almost a certainty of other than present ownership, the engineer must find real intrinsic values and disregard that greatest of credit assets, personal reputation.

Water Plant Now the City's

Municipal engineering works in Denver now include the water problem, and the biggest part of that problem is how to get money for improvements and still retain the citizens' confidence. Aside from the troubled financial and political aspects an inspection of the system has always been worth while because of the numerous sources of supply and the many kinds of treatment employed. When the city took over the plant last year business men succeeded to the control, but most of the former operating staff, efficient and hard working as ever, was retained. Little change is noted anywhere except in the front office. Here the former "sleepless-night" anxiety is still in evidence, because of the increasing consumption and inadequate funds for new construction. An admitted error was made in voting bonds sufficient only to buy the plant, providing little or nothing for much-needed extensions, for replacing obsolete and worn-out machinery and for conduits that have outlived their designed length of life. Usually, previous to the purchase of a utility by a municipality, money cannot be found to keep a plant far ahead of year to year requirements. The Denver plant is no exception. In fact, the case is exaggerated, for the company and city have kept the courts busy with their contentions since the early nineties. Now the commission must sell to the citizens the idea of increasing the indebtedness if good service is to be maintained. Several millions are needed. Shall it be raised by bond issue, by an increase in water or in tax rates, or by some flat front-foot-readiness-to-serve charge, thus making the vacant lot owner bear his share. Naturally, metering also is under consideration, but the past education of the public has all been away from that viewpoint. Strange enough, several engineers, mostly irrigation, hold to the idea that meters are impractical in an irrigated country if lawns are to be maintained generally.

Engineering society life in Denver dates from 1909, when members of the American Society of Civil Engineers were able to induce the parent body, almost unwillingly, to permit the formation of a Colorado Association. A strenuous debate occurred at the first meeting between those who wanted to admit Am. Soc. C. E. members only and those who wanted to let in non-members. The exclusives won out. Looking at it from a distance, two quite divergent consequences would doubtless have followed had the minority prevailed. The Colorado Society of Engineers would have come into being then rather than nearly 10 years later, but its personnel and objective might have been so different that the virile things it is now doing, particularly along welfare and civic lines, might never have been accomplished. At present the younger society is distinctly the dominating one. Its meetings are well attended, and it does not refrain from putting on rival technical meetings, although it considers non-technical work its field. The miners and mechanicals have societies in Denver, and an Engineering Council, made up of representatives of all technical societies, is attempting to face and serve the public with a single solid front. Colorado engineers have the machinery to fall in with any national federation proposed; in fact, they have been waiting for it some time.

The typical Colorado engineer is a sociable individual, willing to travel a hundred miles to attend a two-dollar dinner. He makes less fuss over it than would his back-East suburban-commuting brother in Chicago to staying downtown in the loop. There is something in the ozonized air, altitude or continuous bright sun, that provokes a Coloradoan, engineer or not, to argumentative discussion. M. L. Holman of St. Louis holds that people, normal back East, become otherwise once they get into Colorado, and George G. Anderson once argued with the writer on a street corner for a half hour on the effect on the eyes and brain of the glaring sun. At any rate, start a debate at a regular Wednesday noon luncheon of Am. Soc. C. E. members and the subject will receive round-table treatment without pussy-footing. Everybody knows where the other fellow stands. Rivalry is keen, occasionally leading to uncharitable condemnation, for the Western engineer is outspoken.

As to his deeper nature and inner feelings on the real things of life the Colorado engineer is a far more serious citizen than he is usually given credit for. Prof. L. G. Carpenter, head of the Colorado State Council of Defense, who had an unusual opportunity during the war to learn the inside story of many Western engineers, has stated that he was astounded at the calculated sacrifices and profound thinking through to a logical conclusion of many an engineer apparently unconscious of civic responsibilities. We will never know what the average engineer thinks, he says, but the war came nearer than anything else to making him show it by action.

DENVER, COLORADO.

Tests of Stored Cement

Tests were made last year by the United States Bureau of Standards on cement which had been stored for a considerable period. In some cases the storage period amounted to more than a year. Several such samples were submitted for tests. The results of tests indicated reduction in strength for the storage cement, but this change was not marked for material which had been stored on the job for less than one year. One lot, which had been in storage over two years, gave the same strength of compression for 1:1–½:3 concrete as was obtained for a 1:2:4 concrete made with the same brand of new cement. The old cement was with a 5 per cent calcium chloride solution, and showed an increase of about 30 per cent in 7 days over the same cement with ordinary mixing water.

Proportioned Aggregate Hauled in Ten-Batch Trucks

Reinforced Slab Laid Directly on Old Bituminous Macadam—Two-Bag Batch Paver Averages 80 cu.yd. in Place Per Day

TWO trucks delivering proportioned aggregate in boxes and one truck delivering cement in bags successfully served a paving mixer which averaged 270 lin.ft. a day on concrete road construction near Buffalo, N. Y. A two-bag batch mixer was operated and the aggregate boxes held 3 cu.ft. of sand and 6 cu.ft. of stone. The aggregate trucks made twelve trips a day carrying ten-batch loads. Compared with serving the mixer from stockpiles on the grade, this method was estimated by the contractor to have reduced by one-half the number of workmen required.

Some years ago the road, which is a main traffic route in Erie and Niagara counties, was surfaced with waterbound macadam and later with bituminous macadam. This top had become increasingly difficult to maintain and it was decided to resurface portions of the road with concrete, and, since the old surface was in fairly good condition, to place the concrete directly on the old road. A wire-mesh reinforced slab uniformly 6 in. thick of 1:1½:3 concrete was adopted.

Materials were delivered in bottom-dump cars to a railway siding where the loading plant was located. This plant consisted of a two-compartment elevated bin to which the sand and stone were delivered by a bucket conveyor or from a pit under the siding. By locating the conveyor on line with the bin partition delivery was made to either compartment by shifting the discharge chute at the tops of the conveyor. Gates in the bottom of the bin delivered sand and stone to the batch boxes on motor trucks which passed underneath the bin to receive their loads. In charging, sand was first run in to mark and then the box was filled to the top with stone. Ten batch-boxes exactly filled the truck body.

Home-made, wooden batch-boxes were used. Through each box, just above the center of gravity of the load, a steel rod was inserted so that its ends projected about 6 in. outside the box. Hooks on the hoisting yoke of the mixer crane engaged these projecting ends in handling the boxes to and from the truck.

BATCH BOXES ON TRUCK LOADED FROM ELEVATED BIN

To permit motor truck delivery alongside, the mixer was operated on one side instead of at the center of the new pavement. Arriving at the mixer the truck

CRANE ON MIXER UNLOADS BATCH BOXES FROM TRUCK

was unloaded, a box at a time, by the mixer crane. The boxes were emptied into the charging skip by tilting them bottom up while suspended from the crane. When operations proceeded smoothly, it required about 1½ min. to handle a box or 15 min. to unload a truck. Cement in bags was piled near the mixer for hand charging.

From a count made recently when visiting the work it was found that an average of 270 lin.ft. of slab was being laid with three trucks hauling aggregate and one truck hauling cement. The operating force and the estimated wage cost for hauling materials and placing concrete were about as shown by the table.

ESTIMATED OPERATING COST OF HAULING MATERIALS AND CONCRETING HIGHWAY NEAR BUFFALO, N. Y.

Item	Cost
4 motor trucks at $25	$100 00
3 men at bins at $3.50	10 50
2 men on cement truck at $3.50	7 00
1 man on crane at $3.50	3 50
2 men charging mixer at $3.50	7 00
3 men spreading concrete at $3.50	10 50
2 men finishing at $3.50	7 00
2 men on forms at $3.50	7 00
1 engineman	5 00
1 fireman	4 50
1 foreman	6 00
Total	$168 00

Wing & Munger, of Holley, N. Y., were the contractors for the work which was executed under the general supervision of Charles J. McDonough, Engineer Ninth Division, New York State Highway Department. W. N. Harris was the engineer in charge.

Article on Structural Teaching—Correction

In the article, "A Call for a Practical View in Structural Teaching," by Edward Godfrey, *Engineering News-Record* May 13, 1920, p. 948, two typographical errors occurred: The word "no" opposite the middle of Fig. 1 should be omitted and the word "connecting", four lines below Fig. 2, should be "connoting".

Denver & Rio Grande Terminal at Mountain Summit

Coal Traffic Is Governing Factor in Selection of Site for New Division Point—Steep Grades Limit Yard—Unusual Layout for Tail Switching—No Turntable or Track Scale

IN SELECTING a mountain summit at the apex of steep grades as a site for a main line division terminal with large freight yards, the Denver & Rio Grande R.R. made a radical departure from ordinary practice in locating division points which has evidently been justified by improved traffic conditions. This new terminal is at Soldier Summit, Utah, at an elevation of 7,440 ft. It supersedes a former division point at the foot of the grade on the eastern slope. The location was selected in order to effect economy in the handling of heavy coal traffic on long grades of 2 per cent, with loaded movement mainly in one direction and empty car movement in the opposite direction. Topographic conditions limited the space available and imposed exceptional difficulties in planning the layout of the yards and terminal facilities. The traffic averages twenty trains daily, ten in each direction.

Coal traffic was the governing factor in both the location and the design of the new terminal. The Utah coal fields are on the eastern slope of the Wasatch Mountains, but practically the entire output is shipped westward and has to be carried across the mountains, through the pass at Soldier Summit. In 1918, selected as a typical year, the coal and coke moved westward through this gateway aggregated about 4,500,000 tons; other freight increased the total westward bound traffic to 5,000,000 tons. Eastbound freight, which does not include any coal or coke, was about 900,000 tons.

Loaded and Empty Train Movements

On the eastern slope, the maximum ascending grade is 2.4 per cent, and as pusher engines were required for the heavy trains a division point was located at Helper, 25 miles from the summit. Prior to 1913, the maximum descending grade on the western slope was 4 per cent and the braking capacity of loaded trains limited their tonnage materially, the average weight of westbound trains from Helper being then about 850 tons, handled on the down grade by a 110-ton engine of the 2-8-0 class.

To improve this condition a 28-mile double-track detour line having a maximum grade of only 2 per cent, was built from Soldier Summit to Thistle. Since 1913, therefore, it has been possible to operate trains of any length and weight economically. At present the solid westbound coal trains starting from Soldier Summit average 65 cars and a total weight of 4,000 tons (instead of 850 tons), handled by a single road engine of the class mentioned above. The trains are of approximately the same weight in summer and winter.

Owing to the widely separated points of production of coal and coke on the east slope, the collection of loaded cars from these points is effected necessarily by numerous short trains which operate on branch lines and on the ascending grades of the main line. It is evident that it would be an advantage to assemble this traffic at a point where solid trains could be made up for the westerly movement. The logical location for such assembly was Soldier Summit, because it is the first station beyond the most westerly junction where coal reaches the main line and because westbound trains encounter no adverse grades beyond the summit. Thus full tonnage trains can be operated to junctions and interchange points

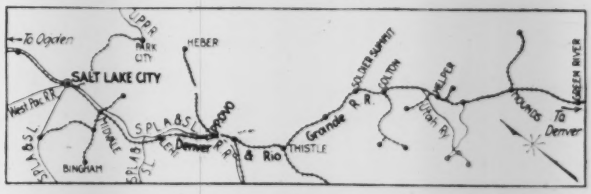


FIG. 1. LINES SERVED BY YARD AT SOLDIER SUMMIT, DENVER & RIO GRANDE R.R.

from which the coal traffic is distributed. These conditions are explained by the maps and profile, Figs. 1 and 2.

Another factor in selecting the division point was the thorough train inspection and air-brake test that must be made on all trains descending from the summit in either direction. For safety and efficiency it is desirable to have this work done where all necessary facilities and appliances are in the hands of a well organized force of inspectors. But it is difficult to maintain competent forces and adequate facilities at outlying points, so that a division terminal is the logical place for such inspection.

Empty car movement is an important element in the operating conditions. Westbound through freight traffic is of such character that there are no empty cars from the east available for loading with coal and coke for further movement westward. It is necessary therefore, to bring in sufficient empty cars from the west to be distributed to the mines for loading and then to be assembled in westbound trains. With the maximum grade against eastbound traffic reduced from 4 per cent to 2 per cent it was practicable to haul long trains of empty cars from the west, such trains now averaging about 75 cars. These trains had to be broken up, however, for distribution of cars in short trains to the mining centers. For this purpose, Soldier Summit was again the logical point. Further, labor conditions were favorable to the selection. With a terminal here it is practicable and economical for engine and train crews to make daily trips delivering empty cars to the mines and bringing back loaded cars within the periods prescribed by the law regulating hours of service.

A very desirable equalization in length of operating divisions was effected by the establishment of a division terminal at Soldier Summit. With the terminal at Helper, there was an eastern division only 72 miles long to Green River, but the western division to Salt Lake City was 119 miles long and included all the mountain grades grouped at its eastern end. With the division point transferred to the new location, the lengths of the two divisions are 97 and 94 miles respectively.

A marked economy in time and car service has resulted from the new operating conditions and has proved the wisdom of selecting this location for the division terminal. When the old terminal was at Helper, a coal car required an average of 8.1 days for the round trip from Salt Lake City, going empty to the mines and returning loaded. Since the Soldier Summit terminal has been in operation the time for the round trip has averaged only 5.5 days, a reduction of about 30 per cent, which means a corresponding increase in the capacity of the car equipment.

Freight Yard Layout

In planning the freight yard arrangement to meet the special conditions of the heavy traffic at this point the following requirements were governing factors: Receiving yards for long trains of empties (100 cars maximum) from the west and shorter loaded trains (50 cars maximum) from the east; a departure yard for westbound solid coal trains; a combined classification and departure yard for eastbound trains of empty cars (50 cars maximum) for distribution to the mines. A layout suitable for these conditions would provide ample facilities for handling the through main line freight traffic in addition to coal and coke.

Topographical limitations also exerted a governing influence in the design of the yard layout, the trackage having to be confined within narrow limits. Much study was devoted to obtain a favorable utilization of the space available, owing to the heavy expense of grading a site and to the fact that any lowering of the summit elevation was out of the question. Even with this careful attention to adapting the layout to the topography, there was about 460,000 cu.yd. of excavation for grading, most of this being solid rock. All yards and terminal facilities are on the north side of the main line.

Limited extent of level ground for a yard at the summit of heavy grades necessitated special arrangements to secure a layout suitable for economical operation and having tracks of the required length. The main line has a level stretch of 2,750 ft., approached from the west by a 2 per cent grade and from the east by a 1 per cent grade followed by 1,600 ft. of 0.56 per cent. In its original alignment the main line included considerable curvature in conforming to the topography of the mountainous country.

Traffic requirements demanded tracks at least 4,400 ft. long, capable of holding 100 cars, these tracks preferably being straight. Tracks of this length, however, would extend over the 1 per cent and 2 per cent grades at the east and west ends respectively, making it impracticable to handle switching movements from either end. As the first step, the double track main line was shifted south and relocated so as to give the greatest possible length of tangent and still connect with the old alignment at each end. The yard tracks were then laid out parallel to this tangent and continued eastward as straight lines to obtain the necessary length, a connection on a curve of 8 deg. being then run from the east end ladder tracks to the main line, as indicated in Fig. 3. The total distance between the main line crossover connections at the ends of the yard is 7,758 ft.

Yard Switching Movements

Operation of the yard by switching from the ends was precluded by the relatively great length of tracks and their connection with heavy main line grades, as noted above. To overcome this difficulty at the west end, a stub tail track or drill track, 1,600 ft. long was led from the throat of the yard on a supported ascending grade of 1 per cent, diverging from the main line by a curve of 8 deg. as shown on the plan. Cuts of 40 cars can be pulled from the westbound receiving yard to this drill track and then switched down the 1 per cent grade into the long westbound classification tracks. Switching for the eastbound yards is operated on the ladder near the middle of the layout, the cars on the receiving tracks being pulled westward and then pushed into the eastbound classification tracks.

Unusual arrangement of the yard units will be noticed on the plan. Ordinarily the westbound receiving yard would be at the east end of the layout and cars would move west through the several units to a westbound departure yard at the west end. At Soldier Summit, however, the westbound receiving yard is at the west end of the site, with its corresponding departure yard adjacent to and parallel with it. The tracks of this latter yard are continued east to form the eastbound receiving yard, which in turn is parallel with its corresponding departure yard. Thus inbound trains entering the terminal from either end pass to the opposite end before being set on the switching tracks to be broken up or separated. The westbound receiving yard has seven tracks about

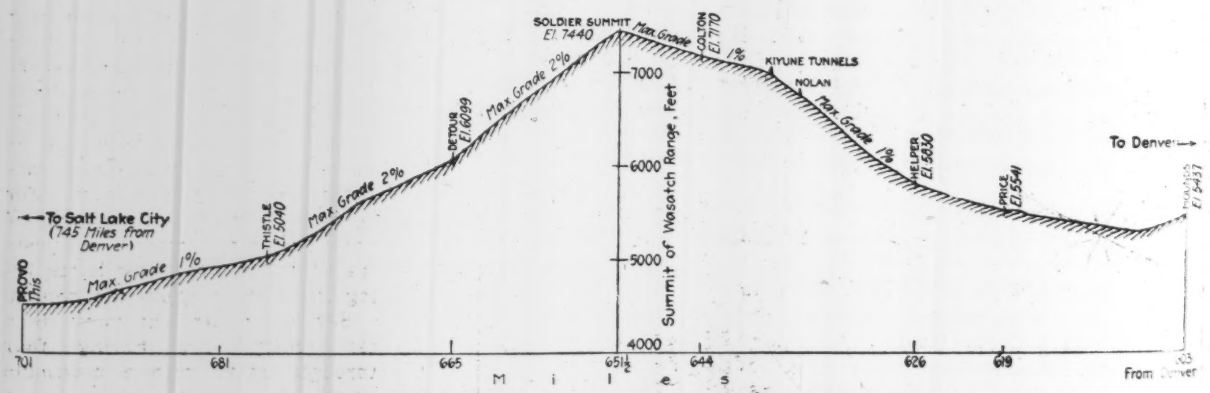


FIG. 2. PROFILE OF LINE OVER WASATCH MOUNTAINS

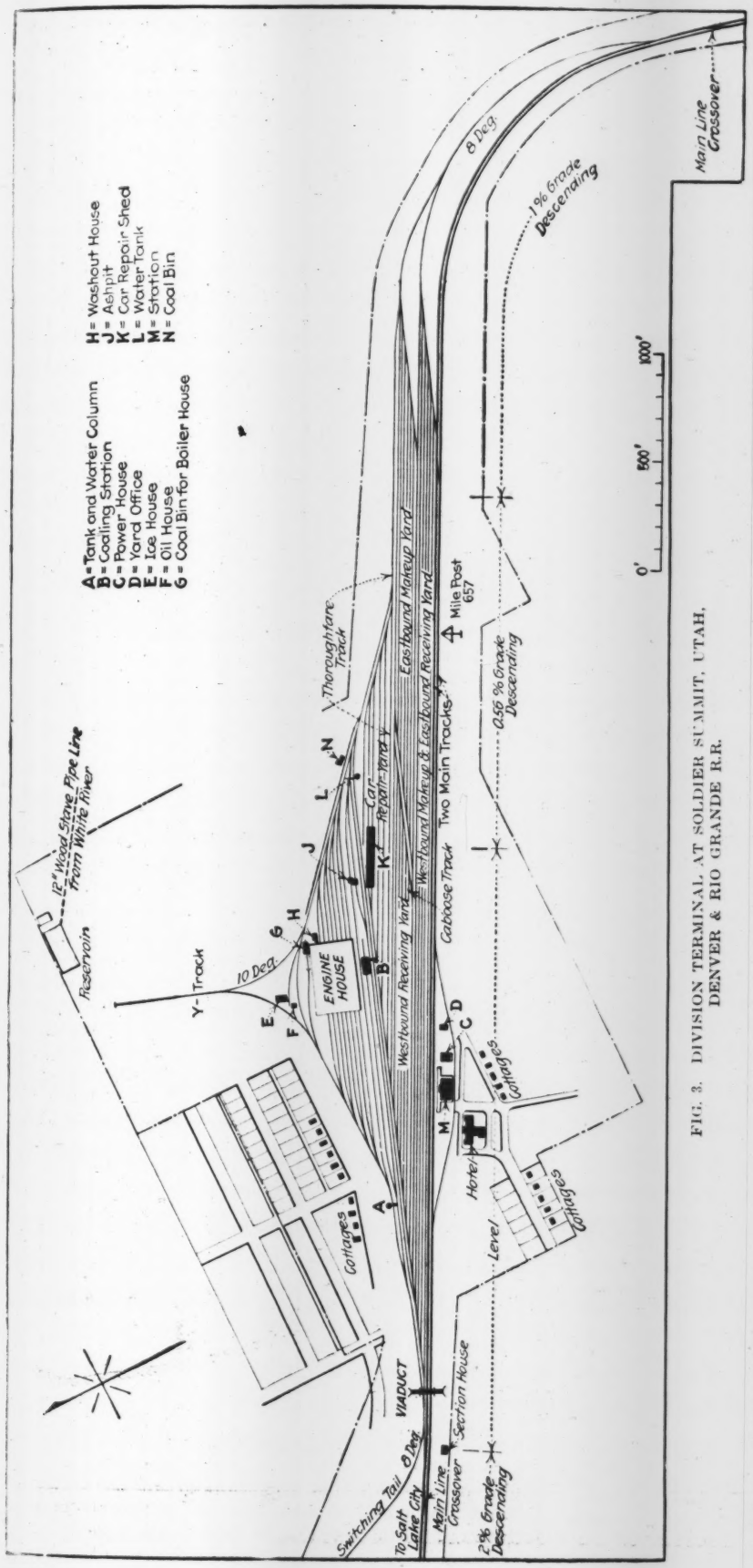


FIG. 3. DIVISION TERMINAL AT SOLDIER SUMMIT, UTAH, DENVER & RIO GRANDE R.R.

2,000 ft. long; the eastbound departure yard has six tracks of the same length, and the combined westbound departure and eastbound receiving yard is composed of six tracks about 4,400 ft. long. No difficulty is experienced in handling both eastbound and westbound trains on these long tracks.

Yard tracks are spaced 15 ft. c. to c. and the same spacing is used at main and lead tracks. Ladder tracks are on an angle of 8 deg. and where they are double the tracks are 15 ft. c. to c. All tracks are laid with 85-lb. rails in gravel ballast. Yard turnouts and main line connections have 16½-ft. switch rails and No. 10 frogs. Departure tracks are equipped with compressed air piping for testing the brakes on trains made up ready for the road engines. No special provision is made for clearing snow from switch and yard tracks.

A caboose track is provided between the westbound and eastbound departure yards, and has a ladder track connection at each end, as shown on the plan. Caboose cars do not pass through this terminal, as it is a division point. When an eastbound train arrives, the caboose is uncoupled and a switch engine sets it on the caboose track, from the east end of which it is switched into the east end of the departure yard to be coupled to the rear of an outgoing westbound train. In the same way, a caboose from an arriving westbound train is set on the caboose track and then moved through the west end for switching to an outgoing train in the eastbound departure yard. A thoroughfare or running track is arranged between the car repair yard and the westbound receiving yard.

As coal cars are weighed at the mines no track scale has been installed at the yard, but the original design includes this equipment for the purpose of both checking and weighing. All ordinary freight is through traffic and no facilities are required for handling less-than-carload freight, but provision is made for icing refrigerator cars and for watering stock cars. For lighting the yard, electric lamps of 1,000 cp. are installed on posts spaced 400 ft. apart, the lamps being about 45 ft. above the ground.

Beyond the freight yards is a car repair yard having four through tracks with a maximum length of 1,300 ft. and one short stub track for material. Two of

the tracks are partly covered by a repair shed. These car repair tracks are spaced 20 ft. c. to c. and can accommodate a total of 100 cars. They are equipped with compressed air piping for pneumatic tools.

A rectangular concrete enginehouse 200 x 326 ft., having eight through tracks connected to lead tracks at both ends, is a striking feature of the engine terminal. It was found that this arrangement permitted a more economical and convenient utilization of the space than the usual arrangement of a roundhouse with tracks radiating from a turntable, while it eliminates the trouble of keeping a turntable pit clear of snow in winter. A Y-track with 10 deg. curves and connecting with the enginehouse leads provides for turning the engines. The building can accommodate 24 locomotives. Road engines of westbound trains are cut off in the receiving yard and move forward to a ladder track from which they move back either to the coaling station or the enginehouse. Road engines of eastbound trains move forward to the loop connecting with the main line and then back into the engine terminal. For switching service, there are three yard engines, in addition to which the engine terminal has to provide for cleaning, coaling and handling about 65 road engines daily.

There being no town at this point, housing accommodation had to be provided for about 200 men and their families. The railway company laid out a townsite and built ten 6-room and ten 4-room frame cottages. A sewerage system connected to a septic tank was also built. Several more cottages have been brought to this site from the former division point at Helper, which is now abandoned. A frame hotel provides for transient and unmarried employees, and a Y. M. C. A. building is being erected. The railway station is a two-story frame structure 36 x 100 ft., with division offices on the upper floor.

The planning of the entire terminal and the design and construction of the various parts were carried out under the direction of J. G. Gwyn, chief engineer, and Arthur Ridgway, assistant chief engineer, Denver & Rio Grande R.R.; L. B. Furman was resident engineer in charge. All track work was done by company forces. The new division point was put in service in November, 1919, and represents a total expenditure of about $1,250,000.

Cement Plaster on Gypsum

Researches have recently been carried on by the U. S. Bureau of Standards, looking into the subject of the adherence of cement plaster to gypsum. The findings are reported as follows:

There seems to be no detrimental reaction between the two materials; the tensile strength of the mixture of gypsum and cement is very nearly equal to their combined tensile strengths dependent upon the proportions of the two ingredients used.

The suction of the surface to which the plaster is applied is an extremely important factor; for example, if gypsum plaster is applied to a dry concrete surface, the suction of the concrete will take so much water out of the gypsum that it will prevent its proper hardening.

The expansion of neat cement, when wet, is of an entirely different order fromm the expansion of neat gypsum, and a bond between the two materials can be permanently maintained only when enough sand is added to both materials to reduce the same for both.

Bureau of Public Roads Begins Highway Subgrade Study

District Engineers to Select Soil Specimens Where Roads Fail as Aid in Securing Data on Soil-Bearing Power

IN ORDER that every effort possible may be exerted immediately to obtain accurate scientific information regarding soil characteristics producing high or low bearing value, the Division of Tests, U. S. Bureau of Public Roads, has begun investigations in the vicinity of Washington, D. C. As little can be accomplished there that will be of anything but local value, the Chief of the Bureau of Public Roads, Thomas H. MacDonald, has, in a circular letter, recently addressed all the district engineers soliciting their assistance.

Working upon the assumption that all soils have adequate bearing value when the amount of water within them is kept at a low percentage, or that other soils may be rendered of greater value if artificially treated, a thorough study of subgrade conditions will be made first-hand. To get the needed information district engineers are directed to make investigation of soil conditions where failures in road pavement have been noted, the failure being obviously due to poor soil conditions. They are asked to work in co-operation with the various state highway departments in securing this information and in making inspections of road failures due to poor subgrades.

Inspections will include taking samples of 1 cu.ft. from the subgrade, preferably directly under the failures; the taking of photographs of the site of the failure; and complete information regarding the topography of the road in the vicinity of the failure. Detailed information regarding the character of the failure is also to be noted, as well as the approximate

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

Investigation of Road-Failures Produced by Failure of Subgrade
Name of Road and Location (State, Co., Towns).....
Type of Road.....
Year Built.....
Volume and Approximate Character of Traffic.....
.....
Description of Drainage: Ditches, underdrains; drains under road: size or dimensions. (See attached Sheet 2).....
Location of Failure: (State how far from top of grade, per cent grade, whether in cut or fill, on side hill or on flat, as well as geographic location.) (See attached Sheet 2).....
.....
.....
.....
Photograph of Failure, Film No.....Negative No.....
Photograph of Road Cross-Section, showing surface drainage conditions, Film No.....Negative No.....

Data on Soil Sample (1 cu.ft.)

Identification Mark: (State, County, Sample No.).....
Location of sample with respect to road (horizontal and vertical location).....
Does material as represented by sample extend at least 3 ft. below road surface?.....
Is there any indication that a more porous or a more impervious layer underlies this material.....
At what depth?.....Small sample marked.....
Note proximity of water, whether in ditches, in seepage strata, on surface, on shoulders, etc.....
.....
.....
.....
State your opinion as to how the water reached the subgrade, whether by vertical or horizontal capillarity, from surface, from underlying seepage strata, etc.....
.....
.....
.....
Are drains operating?.....
Is outlet above or below water surface or ground?.....
Remarks:.....

INFORMATION SHEETS WILL CONTAIN ROAD FAILURE DATA

amount of traffic, drainage conditions, the probable presence of water-bearing strata, or other features that may make for a wet subgrade. Particular attention is to be paid to the manner in which water reaches the subgrade, whether by vertical or horizontal capillarity, through seepage strata, from the surface, etc.

Sample bags with tag envelopes in which to ship soil samples to the Division of Tests are provided, as are blanks upon which road failure information can be tabulated.

The memorandum from Mr. MacDonald to his various district engineers is given herewith:

It would seem to me to be very desirable in view of our enormous road building program that every effort possible be made immediately to obtain accurate scientific information regarding the characteristics of soils which render them of high or low bearing value, as the case may be.

The Division of Tests at Washington has begun an investigation in the vicinity of Washington with this idea in view but little can be accomplished along this line unless a nation-wide research be made obtaining the services of various co-operating agencies. The problem of eliminating road failures due to poor foundations seems to be possible of solution in one of the following ways:

(1) Make the road surface thick enough so that the pressure will be sufficiently distributed to the underlying subgrade, or so that the surface because of its inertia may absorb a considerable amount of the shock of traffic, or

(2) Design the slab to have sufficient strength to bridge over the soft subgrade, or

(3) Improve our drainage systems to exclude the moisture in dangerous amounts from soils which are rendered of very low bearing value by the presence of water.

It is perhaps true that all soils have adequate bearing value when the amount of water in them is kept to a sufficiently low percentage, or it may be possible that certain soils will be susceptible of treatment which will render them of higher bearing value than they have in their natural state. It is obvious that if we are to advance our ideas regarding road construction we must begin with the road foundation and must gain accurate information as to what properties of soils make them good or poor soils for foundation purposes. With this knowledge in hand, we will then be in a better position to say how the road should be designed when it is to be laid on these particular soils, or possibly how we should treat the soil when its characteristics are known in order to increase its bearing value.

With the idea in mind of gaining this preliminary information, I should like to have you obtain the co-operation of the various state highway departments in your district in an investigation of soil conditions existing where failures due obviously to poor soil conditions have occurred in the roads. I would suggest that you designate someone in your district to make an inspection of a number of road failures due to poor subgrades, whether due to poor drainage or to peculiar soil conditions, working in co-operation with the state highway departments and also, wherever possible, with the state geologists.

In this inspection samples of one cubic foot each should be taken from the subgrade, preferably directly under the failure, photographs should be taken of the site of failure, and complete information should be given regarding the topography, preferably in the form of cross-sections and profile of the road in the vicinity of the failure. Notes should be taken regarding the character of the failure, the approximate amount of traffic, drainage conditions, the probable presence of water-bearing strata, or other conditions that may make for the wet condition of the subgrade. It is particularly important that data be given tending to show how water reached the subgrade, whether by vertical capillarity, horizontal capillarity, through seepage strata, from the surface, etc. An auger 1½ in. in diameter will be useful to explore the underlying subgrade and much useful information may be obtained by noting the texture and condition of moisture of the soil at different depths. Thus if the soil at the surface is wet, and is very compact, dense and dry below, the probability is that the water entered the subgrade from the surface and was prevented from escaping by the underlying impervious layer. If the underlying layer of a wet subgrade is wet and porous and it in turn is underlain with compact impervious clay which is dry, it would seem that the porous layer is a seepage stratum through which water is flowing and is rising to the top of the subgrade by vertical capillarity. A number of combinations of conditions are to be expected and must be carefully studied to determine how the water which existed in the subgrade at the time of failure arrived there.

Similar samples and observations should be taken from spots in the same road which have not failed. The samples so taken should be sent to the Bureau headquarters at Washington, where they will be subjected to suitable tests. Bags of one cubic foot capacity are being sent to you for use in this investigation. If the texture changes down to a depth of 5 or 6 ft., as determined with the auger, take a 1-qt. sample and place in small white cloth bag provided for this purpose.

This preliminary investigation need not be very extensive so far as the number of samples are concerned. If samples are secured from fifteen bad failures in each district, together with five samples from parts of the same roads which did not fail, these samples will serve the purpose of this preliminary investigation.

I shall appreciate it if you will have this investigation begun immediately. I am enclosing herewith a number of blank forms which should be used by the engineer assigned in your district to this work. I am also sending under separate cover 20 sample bags and tag envelopes to be used for shipping the samples to Washington. It is suggested that when selecting the failures, differences in the soil characteristics as wide as possible be sought and that failures on fills as well as on cuts be investigated.

Italian Housing Activities

ACCORDING to the U. S. Department of Commerce, the Italian Government has considered several legislative bills designed to increase materially housing facilities throughout the Italian domain. Legislative assistance offered so far includes loans to building organizations, co-operative societies and municipalities; state aid to commercial, industrial and agricultural organizations in the production of houses for their own employees; complete exemption from customs duties of imported building materials; exemption from the normal tax and the super tax for houses coming within the definition of popular or economical houses, as well as popular hotels and dormitories constructed by the municipality for a period of twenty years; and the exemption of certain other buildings not of a luxurious character from the normal tax and super tax for a period of 10 years.

In aiding tenants and discouraging rent profiteering Government commissioners will be appointed in cities of over 100,000 inhabitants to see that tenants receive full protection afforded them by law in connection with the leasing of apartments, furnished rooms, etc., and in regard to eviction. It is also provided that the civil and military offices of the government, having a temporary character owing to the war, must be removed within three months from private buildings. In addition, through a decree of the Ministry of Industry, Commerce and Labor, buildings intended previous to the war for use as hotels and which have been sold for other purposes but are not yet converted, can be redeemed at the selling price, providing a guarantee is given that they will be used as hotels for not less than 10 years.

Pre-Conference Reflections

What the Societies Have Accomplished to Date in Non-Technical Work.

(Editorial Correspondence)

INSTRUCTED or uninstructed, the conscientious delegate before entering into the Organization Conference at Washington, D. C., June 3 and 4 is bound to think back over the past year and reflect upon the achievements of the societies in the field of welfare work. How far along the road of progress has the profession already gone? An appraisal of the work that is now being accomplished is essential, if in his work in the conference he is to utilize rather than upset or disorganize the agencies which have already proved useful.

What, then, are the chief lines of non-technical achievement to be included in such reflection and appraisal? They will come under a comparatively few heads: Compensation, employment, legislation, publicity and ethics; these cover the main part of the field in question.

Under *compensation* the $5,000,000 increase in yearly income obtained for the railroad engineers will doubtless rank as the biggest accomplishment, though the numerous schedules set up in the federal, state and municipal fields have had a remarkable influence in educating the engineer and his employer as to his actual worth. Engineering Council and the American Association of Engineers both started on the railroad question, but the latter followed through. Both have worked hard on schedule-making, but the association is entitled to the credit of more aggressive action in attempting to get the schedules put into affect. Further, the same body earned respect and appreciation by some forceful bits of local work, as when it saved the rapid-transit engineers in New York a holiday season without pay last January. Latest, and from some standpoints most important of the year's achievements in compensation, is another tally for the association, namely, its appointment by the Interstate Commerce Commission as recognized spokesman for railroad engineers on wage questions—the first recognition of any engineering body in such capacity by any public authority in America!

Next, as to *employment*. The younger and lower-priced men are well taken care of by the service bureau of the association, but this has not reached far beyond the $2,400 class of position. The joint employment bureau of the Founder Societies, giving a service less extensive numerically, has probably covered a higher class. Neither service has as yet extended in scope far enough to reach the whole country, though plans are being developed to this end. Meanwhile a number of local societies are doing commendable employment work. Thus, in the intermountain country the Colorado Society of Engineers has gained for itself an enviable reputation.

In *legislation*, the American Association of Engineers points to the license laws on the books of Virginia and New York as its accomplishment, but probably no better general draft of a licensing or registration bill has been brought out than that of Engineering Council. Engineers working locally, without national assistance, have done more work than either of these bodies, however; Iowa, Colorado and Michigan are examples of states that have put through bills with little or no assistance from outside. These states, moreover, afford striking illustration of one great feature of professional activities, for the mere passage of their license bills has galvanized the engineers throughout the state to a realization of the necessity of co-operative activity as never before. Subsequently, the state society of Michigan became a part of the American Association. The Colorado society is so nearly akin to the Association in principle and achievements that it is hard to see why they are apart; the Iowa societies are working on statewide union, but just now are battling over a constitution which may tie them all (including certain chapters of the American Association, anomalously), into a comprehensive organization to be delivered into the Orgonizing Conference fold.

Coming to a different phase of legislation, the work of Engineering Council in furtherance of the proposed department of public works has been highly effective. It is likely to produce a permanent effect on our system of government. Truly, this has been an effective display of the strength of the engineering profession in public service.

What of *publicity* for the engineer and engineering? It would seem that honors go begging. The American Association has obtained columns and columns of newspaper notice, but it has been so largely organization propaganda as to be little more than advertising, in its effect. Let it be said in fairness, however, that the war did much to advertise the engineer.

Good work has been done by local societies in publicity. Iowa engineers obtained a certain amount of valuable press notice during the licensing campaign. Probably the state society has one of the best-laid plans for statewide publicity of engineering so far proposed; it yet needs vitalization.

No national view of the publicity subject has been taken as yet, it would seem, but Engineering Council's success in its propaganda for a national department of public works is indicative of what could be done had it the funds.

In *ethics* there is little progress to record. Valuable work has been done by the American Institute of Consulting Engineers, slowly but continuously, in its investigation of individual questions presented in practice. By contrast, the Western Society of Engineers has still before it, like Banquo's ghost, the Ira O. Baker-C. D. Hill case, seemingly daring neither to dismiss it nor to try it for fear of splitting the society. The American Association of Engineers has the beginnings of a judiciary body for the protection of individual rights in its Practice Committee.

No engineering organization has yet such a virile stable supreme-court-like body as the American Institute of Architects possesses. Until such august bodies are set up, with rules, regulations and authority back of them, consulting engineering will continue to be a hazardous occupation and—to be really and truly pessimistic—engineering as a whole somewhat short of a profession. Plenty of codes have been written, and are still being written, but few are enforced.

Summarizing such reflections, the delegate cannot fail to observe that a great deal has already been done. Most of this, too, is the achievement of the past year, it will be seen on further scrutiny of the facts. The work at which the efforts of the Washington conference

are directed is already going on, apparently. How shall it be continued? What is the best kind of organization for dealing with these and other non-technical matters? That is the delegate's problem. W. W. D.

Cost of Railway Improvement Work Under Government Control

RAILWAY improvements, new construction and additional equipment authorized by the United States Railway Administration during its first two years of control of the railway system represented a total estimated cost of $1,171,131,168, and the cost of work done and equipment purchased during that period aggregated $805,895,738, or a little under 70 per cent of the amount authorized. In 1918, expenditures for capital account were considerably below the amounts authorized, owing to the impossibility of getting work done, but in 1919 the much smaller amounts authorized were exceeded by the actual expenditures. A summary of these results, compiled from the 1919 report of the Division of Capital Expenditures, is shown by the accompanying table. More detailed figures for the 21-month period, to Sept. 30, 1919, were given in *Engineering News-Record* of Feb. 5, 1920, p. 272.

TABLE OF AUTHORIZED AND ACTUAL EXPENDITURES ON RAILWAY IMPROVEMENTS UNDER THE U. S. RAILROAD ADMINISTRATION IN 1918 AND 1919

Years	Additions and Betterments	New Construction	Equipment	Total
Authorized:				
1918	$567,327,140	$49,603,560	$289,247,838	$906,178,538
1919	215,946,749	7,826,263	41,179,618	264,952,630
1918-19	783,273,889	57,429,823	330,427,456	1,171,131,168
Expended:				
1918	272,232,972	21,346,231	180,058,810	473,628,013
1919	237,143,941	10,011,832	85,101,952	332,267,725
1918-19	509,376,913	31,358,063	265,160,762	805,895,738

NOTE.—Authorized amounts represent the estimated cost of work authorized Expended amounts represent expenditures for work actually done.

It is pointed out in the report that when Congress adjourned on March 4, 1919, without making any provision or appropriation for the continued development of the railway facilities, it was deemed necessary by the Division of Capital Expenditures to reduce the proposed budget and to suspend all authorized improvements except where continuance of work was necessary to insure safety and in such cases as progress had reached such a point that it would have been more expensive to stop the work than to continue it, or where the railway companies were willing to furnish the funds necessary to complete the projects. The same condition made it impracticable to order additional locomotives and cars. Although Congress made an appropriation in June, 1919, this did not change circumstances materially, the situation then being that the Railway Administration was not able to furnish large additional amounts for improvements and the railways were not able to finance additional amounts. Further, it was then too late to carry out extensive plans before the end of the year.

To complete the improvement program, exclusive of equipment, the report estimates that from $200,000,000 to $250,000,000 will be needed. This includes projects which were started in or before 1918 but were stopped for lack of funds, projects which were approved under Federal control but were not started on account of lack of credit, and projects which were under construction as necessary for the safe and proper operation of the railways but which would not be completed by the end of 1919. The amounts named are exclusive of those chargeable to operating account.

Asphalt Coating for Exposed Steel in Waterfront Concrete

CONCRETE beams along the San Francisco waterfront, in which the reinforcing steel is exposed, have been under observation for more than two years. In this time the cause of the cracking and spalling has not been definitely determined, but it has been concluded that the deterioration is not increasing (at least not rapidly) and that it will be worth while to put a protective coating over the exposed steel in the more serious breaks without attempting to patch the concrete. A statement about the condition of waterfront concrete at San Francisco appeared in *Engineering News-Record*, March 21, 1918, p. 575.

The damage to the beams was at first believed to be caused by salt which penetrated to the steel and corroded it, the resulting expansion spalling off the overlying concrete. Cracks that have been recognized during the long period of observation have thrown considerable doubt on this theory. For example, practically no exposures of steel occur in piles and comparatively little in floor slabs, while extensive cracking and spalling has occurred on beams, particularly on the under side beneath the railroad tracks. This has lead to the suggestion that vibrations have caused the original cracking through which the salt suspended in particles of moisture has gained access to the steel.

On the other hand, this is not a wholly satisfactory explanation because in some places the concrete has scaled off without exposing the steel beneath and when more concrete was cut away here to get at the steel, the latter was found to be free from corrosion. The possibility that laitance was the cause of this scaling is considered unlikely because it occurs for the most part on the bottoms of beams.

Whatever the cause, it has developed that the effects are not cumulative. At least, if there is an increase in the extent of the exposure, it is occurring so slowly that inspections over a two-year period have shown very little change. Hence, while close observation will be continued the exposed steel is to be protected from the salt air.

This is being done by first brushing the surface well with distillate to insure bond and then painting with E grade asphalt. This coating is being applied only where reinforcing steel is actually exposed, but a generous application is made covering the adjacent concrete on which the surface has been broken.

Teredos Work Under 40 lb. Pressure

Two wood-stave pipe lines through which the Union Oil Co. pumps salt water at Oleum, Cal., have been entirely destroyed by teredos which must have been drawn in through the centrifugal pumps and entered the wood staves from the inside. The pipe-lines were 10 and 12 in. diameter, respectively, and were operated under a pressure of 40 lb. per square inch. The pipes were damaged so badly that they had to be replaced. When detailed examination was made it was found that the teredos were in a thriving condition, some of them having attained a length of 8 in.

LETTERS TO THE EDITOR

May His Tribe Increase and Engineering Publicity Therewith

Sir—Your issue of May 6 carried an interesting editorial on the viewpoint of the public press toward engineering works. Your suggestion as to the source of inspiration of the recent editorial in the Chicago *Tribune* fails, as the following statement will disclose:

On Jan. 12 the *Tribune* published an editorial entitled "A Thrill and a Bridge" and in highly laudatory terms spoke of the iron worker constructing the bridge, and the American flag at the top of the steel span—the leaf was erected in a vertical position. There was no mention of the bridge engineer.

As I was the engineer of bridges for the City of Chicago when the original plans were made—there have been some slight modifications from the original plans—I felt it due the present city staff that they receive some mention. So I wrote the editor of the *Tribune* on Jan. 12 (the letter being published two or three days later) complimenting the writer on the well written editorial, and calling his attention to the fact that the bridge was a highly specialized piece of mechanism, the creature of the engineer's brain. I pointed out that his linotype operator, type setter or newsboy did not make a great paper. The editorial writer, I stated, was an effective link.

So, when the leaves of the bridge were dropped to grade, and fitted nicely together, the same editorial writer, who had thought over the matter, wrote another editorial to which you refer, entitled "Brawn Takes Its Profit from Brains," the last paragraph reading: "The bridge is a monument to the general value of rewarding ungrudgingly those who contribute by their superior ability to the welfare of all."

As you say, it is well for the engineer not to overlook such legitimate publicity of his own achievements. We have been too modest—so if the bridge engineers of the city have gained public credit through some small effort of mine I am content.

A. J. HAMMOND,
Assistant Engineer, Chicago Union Station Co.

Chicago, Ill.

[The possibility we suggested was that the president of the Board of Local Improvements inspired the editorial, "or got the engineer of the bridge to do so." We are quite as well pleased to know that the engineer acted on his own initiative. May his tribe increase.—EDITOR.]

A Plea for Arbitration Contract Clauses

Sir—By virtue of a recent rather costly experience I am even more than ever an advocate of an arbitration clause in contracts. And by reason of such an experience it seems to me that the Associated General Contractors of America could not perform better service than to relieve such a condition as is herein described.

I had a contract in a neighboring state for 18 mi. of highway grading, of which approximately 2 mi. on either end was light team work, and the rest through rock canyons, involving rather heavy excavation. The contract was undertaken in 1915 and labor was abundant and efficient, and a great part of the work was "stationed." From the time we started, Jan. 1, until the job ended, in late November, only one day was lost on account of bad weather.

Grade stakes from which we worked were set at each station and usually the plus 50s, though no stakes were set at grade, with the exception of one which happened to come at the edge of the road bed. No profile was supplied the contractor. During the setting of the stakes, for some reason which I never knew, 40 re-cross-sections were taken and in every instance showed an entirely different ground line clear across the section. Yet no other further cross-sectioning was done. As the work progressed there was a constant complaint of shortage of quantities. Except the two light ends, almost the entire work was sidehill work and the rock easy to handle. We were assured that when the work was completed a remeasurement would be made and all quantities picked up. The remeasurement was made. Working without stakes set at grade we had missed the grade considerably, and low. Finishing stakes were not given until all the excavation was done, so in order to put the road to grade we had to make additional excavation and do considerable back filling for which we received no extra compensation. When we received our final estimate we discovered that including the team work and all other items we were given an average of but 4.7 cu.yd. per man, which we knew to be not over half of the material actually moved.

When we made an investigation we discovered that in the remeasurement a variation of 0.4 ft. was allowed as between the old and the new grade stakes, and in setting slope stakes a variation of 5 ft. from a right angle was not infrequent practice. We asked for an adjustment and were refused. We offered to abide by the decision of an independent engineer appointed by the state. Arbitration of the case as well was refused. Then we sued.

Our engineer secured blue prints showing the first and last measurements, and the forty re-cross-sections were put upon these from notes secured from the highway commission's engineers. It appeared an impossibility to measure the work and so we asked for reasonable cost and came to trial. The three expert engineers I had secured to offer expert testimony, all residents of the city where case was tried, said emphatically that it was impossible to make an estimate from such data as was at hand. Besides the foregoing I had submitted the blue prints to at least twenty engineers, every one of whom said it was impossible to make an estimate.

The judge before whom the suit was tried, though painstaking and interested, was not a technical man, naturally, and at the end of the third day of trial it was discovered he was interpreting the ground line as that line denoting the finished road surface. The result was that the judge found evidence conflicting and technical and he was not competent to pass upon it, but he found a clause in the contract that the engineer's estimate should be final and binding, and he would therefore sustain the estimate as rendered. I question if one could ever find a more painstaking judge, but you can't give a liberal education in engineering in nine days. Had there been an arbitration clause in our contract so that the case could have been reviewed by one who understood blue prints and field notes, I undoubtedly would have received justice.

Then, no contractor would dare go before an arbitrator without a just case and no engineer would care to be reviewed by a competent arbitrator and have an unjust case or a "bonehead" deal shown up.

E. T. JOHNSON.

Portland, Ore.

How Lower Highway Building Costs?

Sir—A few very commendable suggestions were offered by Mr. Collins in *Engineering News-Record*, April 8, p. 703. However, the growing tendency among many contractors is to shift the responsibility of high costs to the inexperienced engineer.

We must all admit that many of us lack experience in highway construction. However, in my twelve years of experience, I have observed that excessive costs and failures are not all due to the inexperienced engineer. In fact it may be said that greater losses are generally due to contractors and superintendents being inexperienced in highway construction. It is a very noticeable fact that few complaints concerning the engineer come to headquarters from the experienced contractor or contractor who is on the ground and is in actual contact with the work. Hundreds of instances can be cited where mistakes made on the part of the superintendent have been reported by him to his headquarters as being the result of errors on the part of the supervising engineer.

It is evident that many requirements on the part of the average engineer or inspector may be justly criticised, however experience has shown that a very small percentage

of the claims or requirements of the engineer is not clearly covered in the specifications upon which the contractors bid, hence cannot be used by the contractor as any claim for excess cost.

Many contractors bid on work with a total disregard for some of the fundamental provisions of the specifications and they then claim undue advantage is being taken of them by the field engineer or inspector when he insists that the basic requirements of the specifications be executed.

It must be admitted that most state road specifications are drawn by engineers who have had a wide experience in construction work, hence most of their provisions are essential to good construction.

It is the inexperienced contractor or superintendent, who is constantly complaining of the decisions of the engineer, not because the engineer or inspector is in error, but because he does not realize the importance of many of the requirements of the specifications.

Mr. Collins remarks: "Cut out some of the fads, such as the cylinder or cone test for determining whether concrete is too wet or not." The principal purpose for inserting such tests in the specifications is to make the specifications complete and thereby eliminate chance for argument with the field engineer or inspector. It is just as important to specify a standard consistency for concrete as to specify standards for the grading or cleanliness of aggregates. When you buy oats, wheat, hay, machinery, gasoline, etc., you expect it to meet a certain established standard. Then why shouldn't the taxpayers expect a certain standard in concrete when they are buying and paying $40,000 for a mile of road, especially when the proper and uniform consistency of concrete may readily affect the strength or usefulness of the road to the amount of 25 per cent?

In reference to states making allowances for materials, facts show that over 90 per cent of all states doing a large amount of road work allow from 75 to 100 per cent on materials delivered. Further, the amount retained by states for work done varies from 10 to 20 per cent. This is not withholding an excess amount of money when it is considered that practically all states are paying for materials delivered.

In reference to hand labor on road work—it is not the engineer who is requiring hand work. Certain results are specified and the machinery company immediately devises some modern machine to do the work and the contractor buys it with the result that it took more time, money and labor to perform the operation with the new machine than it would have done with a simple machine or hand labor.

It is not uncommon to see from $75,000 to $150,000 worth of unbalanced equipment on a road job and then to see the contractor fail to complete 10 miles of road in a season. Contractors have seriously overestimated the value of equipment and in a great many instances overloaded with equipment to the extent that it takes all of their time and energy to keep all of the different units working 50 per cent of the time. Naturally the ledger at the close of the season shows a large expense and a small mileage of work completed.

Excessive equipment is not within itself the cause of excess expense. The chief causes may be assigned to the inability of the contractor or superintendent to keep all units working 100 per cent efficient. The chief reasons why all operations have not been 100 per cent efficient during the past few years are unsettled conditions, poor railroad transportation, uncertain labor conditions and shortage in materials and equipment.

The minor errors or inexperience of the engineer and contractor may cause a few losses and result in a slight increase in prices but let us be conscientious and assign the causes for high cost where they belong, and let the engineer and the contractor unite in an effort to lower highway building costs by attacking fundamental causes.

B. H. PIEPMEIER,
Engineer of Construction, Illinois Highway Department.
Springfield, Ill.

Drop Hammers Excel in Driving Steel Sheeting in Hard Ground

Sir—Since the results obtained are contrary to the opinion which prevails among contractors experienced in driving steel sheeting, a further explanation may be desirable to account for the fact that heavy drop hammers proved more satisfactory than steam hammers in driving sheet piling for Dry Dock No. 3 at the Philadelphia Navy Yard, as stated in the article in *Engineering News-Record*, April 15, 1920, p. 748. At the outset I freely admit that I consider the steam hammer superior to the drop hammer under any but such extreme conditions as were encountered on the work described.

As pointed out in the article, the sheeting was driven around the dock bottom to hold the banks from sliding and to exclude water from the bottom of the excavation. In order to accomplish this it was necessary to drive the sheeting through the gravel and sand strata and well into the underlying red clay. It was the gravel and sand which made the driving so difficult.

Several feet of ordinary sand lay over the gravel stratum, which varied in thickness from 4 to 8 ft., and under this gravel and overlying the red clay was a very hard and closely compacted white sand. The gravel was semi-cemented and contained many bolders up to 1 cu.ft. in volume. This gravel was quite pervious but unless the water was given a chance to flow freely it remained tightly compacted and hard. The white sand closely resembled a soft sandstone. Efforts to dig it with orange-peel buckets of the heaviest type were largely unsuccessful, but if water was allowed to flow over it freely the sand was readily washed away.

In attempting to drive sheeting through this material, the point brought up on the gravel, and from then on until the point entered the red clay, the driving was exceedingly difficult. An attempt was made to put this sheeting down with a No. 0 Vulcan hammer but almost no progress was made. Records were kept of the driving and where the gravel and sand were thickest as many as 2,200 blows of the steam hammer were necessary in order to drive the sheeting home. This pounding naturally resulted in the bending up of the head of the sheeting and several cutoffs were necessary before the required penetration was obtained. When using a heavy drop hammer, weighing from 3,200 lb. to 4,200 lb., considerably better progress was made, although the driving was slow and tedious. Several attempts were made to sink the piles by means of water jets, but the gravel was too heavy and the attempts were unsuccessful. The driving could only be accomplished by striking heavy, solid blows of sufficient force to break down the material at the pile point and force it to penetrate.

To illustrate the difference in the effect of the steam hammer and the drop hammer, I would compare the operation with that of driving a large spike into an oak timber. If a light hammer were used the spike would be very slowly driven and the head would probably be badly battered up. If a sledge were used, the driving would be more rapid and the spike would not be subjected to such severe battering. The blow must be heavy enough to break down the resistance of the material to be penetrated.

Some of the sheeting was driven by steam hammers, and more of it might have been so driven, but the great weight of the steam hammers, the consequent difficulty in handling them, and the necessity of maintaining large boilers for furnishing steam made the use of drop hammers more satisfactory in the long run.

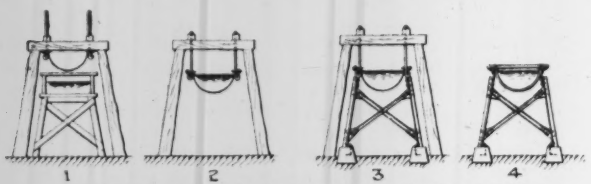
As might be expected, much of the sheeting was found to be badly distorted and bent when the earth was finally excavated inside the lines of sheeting. This does not indicate faulty sheeting. On the contrary, I think it is rather to the credit of the sheeting that it stood up as well as it did under the conditions.

CHARLES A. LEE,
Lieutenant-Commander (CEC) U. S. N. R. F.
Navy Yard, Philadelphia, Pa.

HINTS FOR THE CONTRACTOR

Metal Flume Quickly Erected from Pole Scaffold

BY enclosing the old structure with a pile scaffolding, a metal flume was constructed last season to replace a wood flume and daily irrigation was maintained. The work was performed in Calaveras County, California, on a ditch owned by D. Fricot, and is described by the owner in the *Highway Magazine* for April, 1920. Both the new and the old construction are indicated by the sketches, which show the sequence of operations.



SEQUENCE OF FLUME ERECTION OPERATIONS

(1) Scaffold built and girders hung from hook bolts. (2) Old flume removed and new flume carrying water. (3) Bents hung from girders and footings concreted. (4) Flume finished and scaffold removed.

Using poles cut from the adjacent woods, a scaffolding was built and the girders for the new flume were suspended under its platform and above the old flume by means of long, threaded hook-bolts. When above 200 ft. of girders had been suspended and connected up, water was shut off and the old flume was removed.

Flume removal was begun early in the morning. As fast as the old structure was cleared away the girders were lowered to grade and the curved flume sheets were placed. By the end of the day, the 200 ft. of new flume was sufficiently finished for water to be turned through it. Then the steel bents were bolted to the girders and the concrete pedestals were built up to meet them. When the concrete had become hard, the supporting hook bolts were removed and the scaffold was taken down. The new flumes complete cost about $5 a foot. About 1,200 ft. of the old flume were replaced, as described, with a total of 36 hr. interruption to irrigation.

TNT Practicable for Ordinary Blasting

COMPARED with ordinary 20-per cent dynamite, TNT is stronger and can be as safely handled and cartridged for ordinary blasting operations. Tests in the field, directed by the Bureau of Mines to determine the practicability of the industrial use of surplus TNT accumulated for war uses gave the following results:

As an outcome of investigation in Wisconsin, in the course of which data were obtained for a large number of stumps blasted, it was determined that the necessary charges per square inch of stump cross-section were 0.055 oz. of 20 per cent ammonia dynamite, 0.0387 oz. of TNT, when using a No. 8 cap, and 0.0445 oz. of TNT when using a No. 6 cap. This indicates a slight advantage for the No. 8 cap, and it was believed by the operators that in the use of the explosive a stronger effect was noticeable with the larger cap. Hence in determining a load it seems desirable to allow about three-fourths as much TNT as would be required of the ordinary dynamites.

In ditching about the same results were obtained with a 5½-oz. cartridge of TNT as were obtained with an 8-oz. cartridge of 20-per cent ammonia dynamite. With one cartridge of TNT in a hole, the holes placed 18 in. apart and driven 24 in. deep, and the charge detonated with No. 6 electric caps, a ditch 54 in. wide and about 20 in. deep was made. Approximately the same size ditch was made with 8-oz. cartridges of 20-per cent ammonia dynamite placed in the same way. In rock work very satisfactory results were obtained by using quantities of TNT that were about 75 per cent of those of the 20-per cent ammonia dynamite usually used.

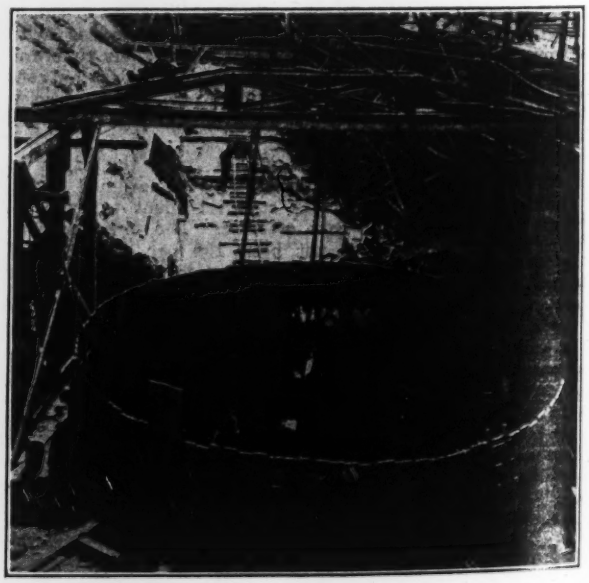
Full details of handling, preparation of cartridges and charging are given in Circular 94, U. S. Department of Agriculture.

Movable Support for Sinking Pumps

By R. E. Post
Seattle, Wash.

IN putting down a pump or enclosed foundation with sheet piles the sinking pumps are often in the way of the pile hammer unless they are handled by a separate derrick, which is an expensive solution of the problem. The bridge shown in the illustration was devised to get around this difficulty and worked very well when used during the construction of the Keechelus Dam at Meadow Creek, Wash.

The device consists of a bridge supported by bents placed outside of the excavation. A rail is spiked to the top of each trestle cap so that the bridge may be easily moved on this rail with a bar. The pumps are hung with cables operated by winches fastened to the bridge itself. The discharge and steam pipes have swing joints to permit of vertical movement of the pumps and have hose connections at one end of the bridge to permit of lateral movement of the bridge and pumps as whole.



NEWS OF THE WEEK

New York, May 27, 1920

Council Committee Reports on Pittsburgh Bridge Case

Direction of bridge design by architects is approved by a committee of Engineering Council, according to a formal statement just issued by council headquarters. The committee consisted of J. Parke Channing, F. C. Shenehon and Henry C. Meyer, Jr.; it considered the question jointly with a committee of the American Institute of Architects, whose representatives were E. J. Russell, William P. Bannister and Richard E. Schmidt. Following is the statement reporting the committee's findings:

Committee's Findings

"The question whether an architect or an engineer should have charge of the design and construction of bridges and other important structures was brought to the attention of Engineering Council by the American Society of Civil Engineers and by the American Institute of Consulting Engineers. Each organization had adopted formal resolutions expressing its belief that engineers should have charge of design and construction of bridges and other structures in which engineering elements predominated. Occasion for these resolutions was given by the engagement not many months ago of architects to have charge of the design and construction of certain conspicuous bridges in Pennsylvania. This perplexing problem has been considered by the joint committee of Engineering Council and the American Institute of Architects. Whether engineer or architect has the primary engagement for a project on which the services of both are needed, an important requirement, frequently neglected, is that the collaboration should date *from the beginning*. Each should be given fair credit for his contribution to the completed structure.

"After a full and frank discussion of the points at issue, the committee, composed of three engineers and three architects, all of whom were present, unanimously concluded that the special conditions surrounding each case should determine whether an architect or an engineer should be selected to have charge. The safety, adequacy, durability and suitability to purpose of any structure, whether bridge or building, are axiomatic. Under certain conditions structures should in addition be aesthetically excellent. In such cases the design must involve, therefore, collaboration between engineers and architects.

"Whether the engineer is chief and the architect associate or vice versa is an administrative detail of relative unimportance. Either combination should secure satisfactory results."

It is not known at this time whether Engineering Council as a whole will consider and act on this report, according to A. D. Flinn, secretary of the council.

Two Engineers Named Directors of U. S. Chamber of Commerce

The U. S. Chamber of Commerce, at its annual meeting in Atlantic City, April 26-29, elected two engineers, Howard Elliott and L. B. Stillwell, as directors of the chamber. Mr. Elliott is a member of the American Society of Civil Engineers and chairman of the board, Northern Pacific R.R. Mr. Stillwell is past-president of the American Institute of Consulting Engineers and of the American Institute of Electrical Engineers; member American Society of Civil Engineers; and is in practice as an electrical and consulting engineer.

Milwaukee Postpones Construction of Fine Sewage Screens

Construction of the fine sewage screens for Milwaukee, outlined in *Engineering News-Record*, March 11, p. 511, has been postponed until conditions are more normal. Meanwhile experiments will be made with another type of screen, which it is hoped will be as satisfactory as the type bid on and less costly. The date for receiving bids was first set for April 8 then postponed until April 22. On the latter date only one bid was received—from the Chain Belt Co., Milwaukee, which had joined with the city in developing the proposed type of bronze plate belt screen at the testing station. This bid was for $258,600, which was more than 100 per cent above the preliminary estimate. T. Chalkley Hatton is chief engineer of the Milwaukee Sewerage Commission.

Urge Appointment of Shenehon

To fill the vacancy in the American Section of the International Joint Commission created by the death of former Governor Glenn, engineering organizations of the Middle West, including the Western Society of Engineers, the American Association of Engineers and the Sanitary District of Chicago, are recommending the appointment of an engineer. Francis C. Shenehon, consulting hydraulic engineer of Minneapolis, is being supported as a logical candidate for the position. Mr. Shenehon's experience covers 30 years' work in connection with the large problems of navigation and water power in the Great Lakes district.

Pension for N. Y. City Employees

A bill providing for pensions for all employees of the City of New York, and also for disability and life insurance, introduced in the New York Legislature and backed by the Rapid Transit Section of the New York Chapter, American Association of Engineers, has been signed by the Governor.

Conference To Represent 100,000 Engineers

Forty-seven Societies Will Send Delegates to Consider Plan for Engineering Federation

Returns received by the Joint Conference Committee up to May 25 show that 47 organizations, with an aggregate membership exceeding 100,000, will send delegates to the Organizing Conference in Washington, D. C., June 3 and 4. Details of the tentative program were announced last week; there will, in all probability, be certain minor changes before the date of the meeting but the sessions will follow the general plan previously outlined. The names of delegates appointed by the American Society of Civil Engineers and the American Association of Engineers appear elsewhere in these columns. There follows the complete list of societies which will be represented:

American Association of Engineers
American Assoc. of Petroleum Geologists
American Ceramic Society
American Concrete Institute
American Electric Railway Engineering Association
American Electrochemical Society
American Institute of Electrical Engineers
American Institute of Mining and Metallurgical Engineers
American Railway Engineering Association
American Society for Testing Materials
American Society of Civil Engineers
American Society of Mechanical Engineers
American Soc. of Refrigerating Engineers
American Society of Heating and Ventilating Engineers
American Society of Safety Engineers
American Water Works Association
New England Water Works Association
Illuminating Engineering Society
Institute of Radio Engineers
Mining and Metallurgical Society of America
Society for the Promotion of Engineering Education
Society of Automotive Engineers
Society of Naval Architects and Marine Engineers
Society of Industrial Engineers
Colorado Society of Engineers
Portland Technical Council
Kansas Engineering Society
Engineers Society of Western Pennsylvania
Mohawk Valley Engineers Society
Florida Engineering Society
Illinois Society of Engineers
Indiana Engineering Society
Brooklyn Engineers Club
Cleveland Engineering Society
Detroit Engineering Society
Vermont Society of Engineers
Society of Engineers of Eastern New York
Assoc. Engineering Societies of St. Louis
Atlanta Joint Technical Society
Engineers Club of Trenton
Engineering Society of Akron
Engineering Society of Buffalo
Engineers Club of Columbus
Engineers Club of Philadelphia
Washington Society of Engineers
Joint Council of Engineers, San Francisco
National Fire Protection Association

Civil Engineer Delegates to Organizing Conference Named

The ten delegates who will represent the American Society of Civil Engineers at the Organizing Conference to be held in Washington, D. C., June 3 and 4, have been named by President Arthur P. Davis. In addition to Mr.

Davis the delegation includes the following:

Richard L. Humphrey, consulting engineer, Philadelphia, and chairman of the Joint Conference Committee.

Francis Lee Stuart, consulting engineer, New York City.

Leonard Metcalf, consulting engineer, Boston.

George G. Anderson, consulting engineer, Los Angeles, Cal.

Gardner S. Williams, consulting engineer, Ann Arbor, Mich.

John W. Alvord, consulting engineer, Chicago.

Willard Beahan, first assistant engineer, New York Central Railroad, Cleveland, Ohio.

Edward E. Wall, water commissioner, St. Louis.

J. C. Hoyt, hydraulic engineer, U. S. Geological Survey, Washington, D. C.

By action of the Board of Direction at its Chicago meeting in April, the delegates will not have power to commit the society to any federation which may be formed at the Washington meeting. The delegates will bring back a report and any further action by the civil engineers must be through a letter ballot to the membership.

A. A. E. Selects 17 Delegates to Organizing Conference

The American Association of Engineers has selected the following seventeen delegates to represent it at the Organizing Conference of engineering societies to be held in Washington, D. C., June 3 and 4:

George W. Fuller, consulting engineer, New York City.

Isham Randolph, consulting engineer, Chicago.

W. H. Finley, president, C. & N. W. R.R., Chicago.

Dr. F. H. Newell, University of Illinois, Urbana.

L. K. Sherman, president, A. A. E., Washington, D. C.

Daniel L. Turner, chief engineer, Transit Construction Commission, New York City.

R. C. Bailey, Washington, D. C.

A. B. McDaniel, professor of civil engineering, George Washington University, Washington, D. C.

William J. H. Strong, Chicago, Ill.

A. N. Johnson, Portland Cement Association, Chicago.

E. T. Perkins, president, Perkins Engineering Co., Chicago.

Dean G. M. Butler, University of Arizona, Tucson.

H. O. Garman, chief engineer, Public Service Commission, Indianapolis.

I. W. McConnell, vice-president, Dwight P. Robinson & Co., Inc., New York City.

Morris Bien, U. S. Reclamation Service, Washington, D. C.

W. A. E. Doying, inspecting engineer, Panama Canal, Washington, D. C.

J. K. Anderson, consulting engineer, Charleston, W. Va.

It has not been announced, at this writing, whether all the members above listed have accepted.

Will Build Large Wireless Station

Contracts were let last week for the construction of a wireless station of great size at Rocky Point, L. I., for the Radio Corporation. The station when completed will have a diameter of more than 3 mi., and will have twelve sets of antennæ supported by 72 self-supporting steel towers 400 ft. high at a distance of 1½ mi. from the power house. It will consist of five units, intended respectively for communication with Argentine, France, Scandinavia, Germany, Italy, and Poland. The cost is estimated at $10,000,000. According to the J. G. White Engineering Corporation, contractors for the station, work will begin immediately.

Most of St. Louis Bonds Defeated by Constitutional Handicap

Although every one of the items in the proposed $24,000,000 bond issue at St. Louis received from 62 to 69 per cent of the vote cast on May 11, and the average majority was some 10,000, only five of the eighteen items were carried, owing to the constitutional requirement of a two-thirds majority. The items are shown in the accompanying table. In planning the bond program, the city authorities had the advice of a committee representing numerous civic and commercial bodies. The bond issue was promoted by a Citizens' Municipal Bond Committee, through newspaper advertisements and otherwise. A Supervisory Committee of seven members, representing as many organizations, was created to represent the public and confer with the Board of Public Service in the expenditure of the proceeds of the bonds. The Chamber of Commerce selected for this committee Baxter L. Brown, ex-president Engineers' Club of St. Louis.

ST. LOUIS BOND ELECTION VOTE

	Amount	Vote* Margin
Elimination of grade crossings	$905,000	+ 872
Purchase and equipment of new parks	1,385,500	— 1,363
Improvement of existing parks	1,174,500	— 658
Municipal auditorium	900,000	— 2,767
Sewers	2,575,000	— 869
River Des Peres improvement	9,000,000	— 2,173
Municipal work farm (to replace the present Workhouse)	400,000	— 3,072
Municipal sanatorium farm (for tubercular, curable insane, feebleminded and infirm)	1,100,000	+ 674
Municipal Bridge, west end approach	1,500,000	— 2,463
Municipal dock and rail terminals	1,700,000	— 1,689
Widening streets	1,250,000	— 821
Fire engine houses and equipment	360,000	+ 930
Bellefontaine farms (delinquent boys)	156,000	— 1,162
Additional cells, City Jail	76,000	— 2,415
Morgue	68,000	— 13
Municipal garage	90,000	— 2,787
Maintenance of streets	360,000	+ 159
Electric lighting system, parks and streets	1,000,000	+ 203
Total	$24,000,000	

*Plus sign (+) indicates number of votes above and minus sign (—) number below the required two-thirds majority. The total number of votes cast ranged from 64,677 for lighting to 64,908 for the auditorium. The registration was 147,105.

Presidential Candidates' Views on Engineer Matters Sought

The American Association of Engineers, through its secretary C. [illegible] Drayer, has addressed to each of the candidates for the presidency a letter in which the candidate is requested to give an answer to each of six questions. The complete letter follows:

At the Sixth Annual Convention of the American Association of Engineers last week a series of six questions was drafted designed to bring out the position of candidates for President on subjects in which the engineer will be especially interested. A resolution was unanimously passed directing that these question be sent to all candidates.

The American Association of Engineers is composed of 18,000 professional engineers rather evenly distributed over the country. They wish to help maintain our government on a high plane of efficiency.

If you will kindly answer the following questions at your early convenience, steps will be taken to acquaint our members and the public with your answers:

1—Are you in favor of a National Department of Public Works, for the purpose of reducing and co-ordinating the present number of bureaus and commissions, and reducing the useless expenditures of money incident thereto?

2—Are you in favor of assembling and co-ordinating all the engineering and construction enterprises of the government (excepting the purely military works) in a department such as the National Department of Public Works, to the end that economy and efficiency will be obtained?

3—Do you favor the appointment of an engineer of recognized ability and unimpeachable character as a member of the Inter-State Commerce Commission?

4—Do you favor the budget system of appropriation of public funds?

5—Do you favor the reclamation of waste lands by drainage, irrigation, flood control or other methods?

6—Do you favor giving the settler the advantage of procuring the land by a sound financial system such as is provided by a rotating fund?

The foregoing letter has been sent to Major General Leonard Wood of Chicago, Senator Hiram Johnson of California, Governor Frank O. Lowden of Illinois, Herbert Hoover of New York, Senator Warren G. Harding of Ohio, Governor Henry J. Allen of Kansas, Governor Calvin Coolidge of Massachusetts, Hon. William Jennings Bryan of Nebraska, Wm. G. McAdoo of Washington, D. C.; A. Mitchell Palmer of Washington, D. C.; Governor James M. Cox of Ohio, and Senator Atlee Pomerene of Ohio.

Mechanical Engineers Discuss New Code of Ethics

A proposed new code of ethics, prepared by a committee of the American Society of Mechanical Engineers, but intended to serve as a basis for a code of principles for all engineers, was discussed at the semi-annual meeting of the society in St. Louis this week. The essential feature of the code is its brevity—it contains but fourteen short paragraphs. The code is intended to be a brief, positive statement of the professional relations of engineers to the public, to their clients or employers, and to one another.

The committee formulating the code recommended the establishment of a standing committee on professional conduct to interpret it, and also to judge cases of questionable ethical conduct on the part of engineers.

Terminal Engineers Elect Officers

At the recent annual meeting of the Society of Terminal Engineers, New York City, the following were elected as officers for the coming year: President, John Meigs; vice-presidents, E. H. Lee, Calvin Tompkins, Charles Whiting Baker, Maurice W. Williams and R. H. McLain; treasurer, W. Joshua Barney; secretary, J. H. Leonard, 20 Vesey St., New York City.

Los Angeles Engineers Discuss Building Ordinance and Terminals

The Southern California Association of Members, Am. Soc. C. E., called a special meeting for April 28. The desirability of having eliminated from the City Building Ordinance of Los Angeles a clause requiring that plans of reinforced concrete buildings have the approval and signature of a licensed architect was called to the attention of those present, and a committee appointed to report on the matter at the next meeting. The association approved the action taken by the American Institute of Architects at its Nashville Convention, in April, by which the institute is bound to observe the decisions of the National Board of Jurisdictional Awards in the writing of specifications, under penalty of suspension from the Institute. Edwin A. Bergstron, president of the Los Angeles Chapter of the institute, read a resolution, unanimously adopted at the special meeting of April 23, which severely condemned the action against alliance with labor unions. A committee of three was appointed to consider the matter in all its phases and to act for the association and to further notify the board of direction of the society and Engineering Council of such action as was taken by this association.

The proposed method of conducting discussion on "Railroad Terminal Situation in Los Angeles" was outlined by President Barnard, who requested that no unnecessary publicity be given in the press until the association had complied with Mayor Snyder's request contained in a letter to the association in which it was stated that "its members are interested in civic affairs and respectfully request that, independent of any special interests or prejudiced advocacy of any plan, they (Southern California Association) discuss its provisions and make, as early as possible, their constructive recommendations in writing to the committee appointed by me." Mr. Anderson, chairman of the committee on review of the railroad commission's report on Railroad Grade Crossings and Terminals in Los Angeles, read a report of that committee, on which there was considerable discussion. The report of the committee is to be printed and sent to the members for study. On motion of Mr. Hawgood, the board of directors was requested to ask Mayor Snyder to furnish the necessary copies of the Railroad Commission's report to the members for their study, to the end that the association could intelligently comply with the request contained in his letter above referred to.

Highway Engineers and Contractors Urge Cut in Construction

The shortages in labor and materials and the lack of transportation have resulted in the recent adoption of two widely separated sets of resolutions urging a cut in construction work to the minimum consistent with the most urgent public needs. The first of these resolutions comes from W. S. Keller, state highway engineer of Alabama, who recently called together all state highway engineers and Federal highway engineers in District No. 8, comprising the states of Alabama, Tennessee, Florida and Georgia. In the resolution, all city, county, state and Federal engineers are urged to co-operate in cutting down as far as possible construction programs for the current year.

In a special meeting held in St. Paul, May 10, the Northwestern Association of General Contractors resolved that in the interest of the public good it was necessary to eliminate all non-essential construction in order to divert labor and materials to "essential productive industry."

No Bids on Pittsburgh Job

No bids were received by the Director of Public Works, Pittsburgh, in response to his advertisement, for the widening and improving of East Carson Street. The estimated cost of these improvements was $315,000 and as contracts are not awarded by the city unless bids are as low as the estimated cost, it is evident that the contractors were not willing to undertake the work at the city's estimate. The specifications will probably be revised and another attempt made to secure bids.

Berresford Heads Electrical Engineers

At the annual business meeting of the American Institute of Electrical Engineers, held in New York City, May 21, the report of the committee of tellers on the election of officers for the administrative year beginning Aug. 1, 1920, was presented, and the following were declared elected: President, A. W. Berresford, Milwaukee. Vice-presidents, E. H. Martindale, Cleveland; Charles Robbins, Pittsburgh; Charles S. Ruffner, New York; C. E. Magnusson, Seattle; C. S. McDowell, U. S. Navy; L. T. Robinson, Schenectady. Managers, E. B. Craft, New York; Harold B. Smith, Worcester; James F. Lincoln, Cleveland. Treasurer, George A. Hamilton, Elizabeth, N. J. (re-elected).

At the meeting of the Board of Directors held on the same date, F. L. Hutchinson was re-elected secretary of the institute for the coming administrative year.

Construction Industries Approve Public Works Department

Approval of the plan for the creation of a National Department of Public Works was given by the membership of the National Federation of Construction Industries in a letter ballot recently canvassed. The two questions submitted were:

"1. Shall the Federation endorse the Jones-Reavis Bill s-2232-H. R. 6649 for the creation of a Federal Department of Public Works?

"2. Shall the Federation endorse the principle of a Federal Department of Public Works?"

The results of the ballot were as follows:

	Question 1. Per cent	Question 2. Per cent
ASSOCIATIONS		
Yes	72.7	100
No	18.1	...
Not voting	9.2	...
	100	100
INDIVIDUALS		
Yes	75.0	92.8
No	17.7	7.2
Not voting	7.3	..
Total	100	100

It will be noted that 100 per cent of the member associations approved Question 2 and that 92.8 per cent of the individuals approved it.

Reclamation Service Changes

On recommendation of Arthur P. Davis, who for several years has been director and chief engineer of the U. S. Reclamation Service, the Secretary of the Interior has changed the title of F. E. Weymouth from chief of construction to chief engineer, with an increase of salary. The title of Mr. Davis has been changed from director and chief engineer to director. There is no change of duties in either case.

Huge Concrete Building for Manhattan

Reinforced concrete has not been used as extensively in building construction on Manhattan Island as in the rest of the country, or for that matter in other boroughs of New York City. There is now, however, under construction the largest building of that type ever built in Manhattan and one of the largest concrete office buildings ever erected. The structure, to be occupied mainly by the Western Electric Co. and the New York Telephone Co., is partly an 11-story office building and warehouse and partly a 5-story and basement warehouse and will occupy the entire block surrounded by Hudson, West Houston, Greenwich and Clarkson Streets. The construction will cover an area of 338 x 200 ft. There will be 583,000 sq.ft. of floor area, and it will be throughout of reinforced concrete, with the exception of a veneer of brick on the exterior walls. Work was begun May 1. It is expected that the owner will occupy the building by May, 1921. The cost of the whole operation will involve nearly $3,000,000. The Turner Construction Co. is the contractor, McKenzie, Voorhees &

Gmelin are the architects, and Meyer, Strong & Jones are consulting engineers on the electrical and mechanical equipment.

Would Extend Payment by Railroads for Betterments

A bill amending the Transportation Act, giving the railroads the right to extend payment of indebtedness, due to the Government for additions and betterments made during the period of Federal Control, over a period of fifteen years instead of five years, as now provided, has been introduced by Senator Cummins, chairman of the interstate commerce committee. The bill also prescribes that the Interstate Commerce Commission, rather than the Secretary of the Treasury, be empowered to designate the security to be offered by railroads in making loans from the $300,000,000 Government revolving fund.

It is understood that the interstate commerce committees of both branches of Congress have agreed to these amendments, suggested by testimony of railroad officers and shippers taken recently before the Interstate Commerce Commission and the Congressional committees.

Secretary of Interior Succeeds Hines as Rail Director

John Barton Payne, Secretary of the Interior, has been appointed by President Wilson to succeed Walker D. Hines as Director General of Railroads, in which capacity Mr. Lane will have charge of winding up the affairs of the Railroad Administration and making settlement with the private managements as provided in the Transportation Act.

Jerry O'Shaughnessy Honored After Fifty Years' Service

On the recent fiftieth anniversary of his entering the service of the waterworks of Columbus, Ohio, Jerry O'Shaughnessy, for many years superintendent, was presented by his associates with a floral tribute and $100 in gold. Illustrated appreciations appeared in the local newspapers. It was with pick and shovel on May 9, 1870, at the age of 17, that Mr. O'Shaughnessy began his long period of service by helping dig the foundations for the old West Side pumping station. When the station was put in use, April 1, 1871, he became wiper. After six months in this position, followed by a like period as fireman, he became engineer at the station, which position he filled for 17 years. He then resigned to become engineer of the Wyandotte Building. After 18 months, or in 1896, he was appointed superintendent of water-works, which position he has held ever since, except for three mayoralty terms when the mayor was a political opponent. Mr. O'Shaughnessy has been a member of the American Water Works Association for over thirty years.

Show Need for More Engineers

That the number of graduates from technical colleges is insufficient to meet the demands of the country for engineers was the contention of educators and representatives of industry at a conference held in Washington May 14 and 15 under the auspices of the U. S. Bureau of Education, presided over by Dr. Walton C. John. Hon. P. P. Claxton, commissioner of education, declared that there was a growing need for closer relationship between industry and the higher branches of education and called attention to the need of more men for highway engineering and motor transport engineering as a result of the rapid development in that field in the past few years. This need was also emphasized by Thomas H. MacDonald, chief of the Bureau of Public Roads, and Roy D. Chapin, president, Hudson Motor Car Co.

Doctor John, in his address, pointed out that 150 colleges were at present giving one or more courses in highway engineering but that only two were offering complete courses in highway and highway transport engineering. A resolution was adopted by the conference calling attention to the need for a greater activity and closer co-ordination between industry and education.

Engineers Consider Licensing

The Lincoln (Neb.) chapter of the American Association of Engineers, May 17, considered the tentative draft of a bill for the licensing or registration of professional engineers and land surveyors in Nebraska. This bill will be one of the principal topics taken up at the meeting of the Nebraska State Assembly of Engineers to which Prof. E. E. Mickey, State University, and G. W. Bates, city engineer, Lincoln, were elected delegates.

Doctor Drinker Retires as President of Lehigh University

Dr. Henry S. Drinker, president of Lehigh University since 1905, has announced his retirement to become effective at the convenience of the Board of Trustees. He will reach the age of seventy this year. Dr. Drinker believes that his work should be turned over to a younger man.

Doctor Drinker graduated from the Lehigh School of Mines in 1871 and entered the Mining Department of the Lehigh Valley R.R. at Wilkes-Barre, Pa. He was engaged in mining and railroad engineering work for the Lehigh Co. for several years, and in 1876 was admitted to the bar and engaged in the practice of railroad and corporation law, becoming attorney and eventually solicitor of the Lehigh Valley R.R. At two different periods he also served as assistant to the president of the road and was vice-president of the East Jersey Water Co. In 1912 he was appointed a member of the executive committee of the new Water Conservation Commission of Pennsylvania.

Ask More Money for Eastern Super-Power Investigation

Although a bill has passed the House of Representatives carrying an item of $125,000 to be devoted to an investigation of the possibilities of the so-called Boston-Washington super-power project, the Secretary of the Interior has asked Congress for a total appropriation of $250,000 for the purpose, and hearings are now being held by the House Committee on Appropriations in consideration of the matter. The investigation would be undertaken by the United States Geological Survey and would cover water, steam, electric, and all power production and distribution in relation to the industries within the territory surveyed.

Conflict in House Reports on Col. Cooper's Muscle Shoals Work

Col. Hugh L. Cooper, consulting engineer, New York City, comes in for some attention in the reports made to the House of Representatives by its special committee which is investigating war expenditures. In connection with the government's nitrate program, the majority report says:

> Anyone who opposed or sought to modify the plans of the President and Secretary of War for the development of Muscle Shoals was either disregarded or disciplined. Colonel Hugh Cooper, builder of the Keokuk dam, and called by the President to build the Wilson dam, advised that the foundations of the dam were probably unsafe, and within the same month was relieved from further service at Muscle Shoals, and sent to France.

The report made by the minority refers to Colonel Cooper as follows:

> As for Colonel Hugh Cooper and the Wilson dam, in March, 1918, Colonel Cooper, who is an eminent engineer and the successful builder of the Keokuk Power Dam in the Mississippi River, was ordered to the Muscle Shoals site to inspect it and to review the plans and recommendations of Major Burgess. This was before the order for its construction was issued and was evidently in preparation for that order. Colonel Cooper performed these duties and made a number of recommendations, the most important of which were fully adopted. It was probably the purpose to have Colonel Cooper begin the work when he went there, if satisfied with the plans but in view of his recommendations, which were highly important, the construction was delayed in beginning until the following August, evidently in order that these recommendations might be considered and the investigations which he suggested made. In the meantime, the services of this eminent officer were needed in the building of an immense dock projected in France, and in May, 1918, he was returned there, being made base engineer at base No. 2 at Bordeaux.
>
> Instead of being disciplined, the suggestions of Colonel Cooper with regard to the dam were largely followed, the investigations as to foundations were made, and while this was in progress he was, because of his recognized ability for the work, sent to another place to serve his country.

Pittsburgh Construction Work Inactive

Shortage of labor and materials in Pittsburgh, coupled with the strike of the railroad trainmen, has caused a radical curtailment of plans for construction work during the present year. The city has available for repaving work about $1,650,000, but under present conditions it will be able to spend but half that amount. The plaza entrance to Shenley Park

will undoubtedly be held over for another year. The Beechwood Boulevard bridge at the entrance to Shenley Park and the Island Avenue bridge will be held over for a year on account of shortage of structural steel. It is doubtful if anything is done on the proposed Boulevard of the Allies this year, except to complete the surveys.

Professor Whipple on Mission To Combat Cholera and Typhus

Prof. George C. Whipple, chief of the department of sanitation of the League of Red Cross Societies, accompanied by Capt. Patrick Kenny, private secretary to Sir David Henderson, director general, left Geneva May 5 for a trip to Roumania on a joint mission for the League of Red Cross Societies and the League of Nations. Conferences will be held with the Roumanian officials and inspections will be made in regard to methods of combatting typhus and cholera, which now threaten western Europe. Professor Whipple expects to spend the month of June in England, July and August in France and Switzerland and September in Italy. He will return to Harvard University about Oct. 1.

Buffalo Engineers Co-operate With Chamber of Commerce

Buffalo engineers and architects have formed a temporary organization as a unit of the new ways and means committee of the Chamber of Commerce of that city. William B. Powell, of Cundall, Powell & Mosher, architects, has been selected as temporary chairman of the organization. The members of the organizing committee include L. A. Harding, Charles Wood, Frederick K. King and Dr. C. C. Derrick. Plans are underway to establish a permanent organization of engineers and architects to co-operate with the Buffalo Chamber of Commerce in promoting the city's engineering and industrial development.

Bascule Supersedes Swing Bridge

A single-leaf double-track trunnion bascule bridge giving a clear navigable channel of 125 ft. is to replace the present drawbridge of the Wabash R.R. over the Rouge River at Detroit, Mich., as ordered by the War Department in connection with the widening of the channel. The bridge is so designed as not to involve any patents on bascule bridges. It will be operated by direct-current electric motors with a gasoline engine for reserve. The main pier of the trunnion end will be carried down to rock but the rest pier will have a pile foundation. To avoid interference with the existing swingbridge the new span will be erected in vertical position. The design and construction are under the direction of A. O. Cunningham, chief engineer of the Wabash R.R. The new masonry will be built and the old substructure removed by the J. W. McMurry Contracting Co., Kansas City, Mo. The erection of superstructure and dismantling of the old bridge will be done by the Kansas City Bridge Co., the steelwork and machinery being fabricated by the American Bridge Co. It is expected to have the new bridge in operation early in 1921.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

ORGANIZING CONFERENCE of National, State and Local engineering societies; Washington, D. C., June 3-4.

The Western Society of Engineers at its meeting May 20 held a general discussion on Chicago terminal problems. J. R. Bibbins, of the Arnold Co., discussed the relation of motor trucking to city pavements and suggested a much more extensive use of electric railways for local freight service. A. J. Hammond, assistant chief engineer of the Chicago Union Station Co., outlined the plans and progress for the new railway terminal. The society has resumed the practice of several years ago in providing an out-of-town excursion May 28 to Madison, Wis., to visit the Forest Products Laboratory, University, Gisholt Machine Co., and State capitol.

The Canton (Ohio) Engineers' Club has been formed with more than one hundred members. Engineers will address the club twice a month, and a library will be installed in the clubrooms. The officers elected are as follows: President, E. J. Landor; first vice-president, H. J. Eberman; second vice-president, H. B. Waha; secretary, J B. Haller; treasurer, L. D. Merry.

The Engineering Society of Western Massachusetts held its first annual meeting at Springfield, May 10. Following the speech of acceptance by C. C. Chesney, the new president, Magnus W. Taylor, chairman of the Industrial Conference Board, spoke on "High Lights on the Present Industrial Situation."

The State Sanitary Engineers' Association will meet in Washington, D. C., May 23-27, at the time of the conference of State and Provincial Health Officers. The organization of the association, started in New Orleans last fall at the American Public Health Association, will be completed. Chairman, C. A. Haskins, State Department of Health, Lawrence, Kan.; secretary, M. Z. Bair (Arkansas).

PERSONAL NOTES

GEORGE M. SMITH, superintendent, Delaware division of the Pennsylvania R.R. Co., at Wilmington, has been appointed superintendent of the Baltimore division, with headquarters at Baltimore. He succeeds GEORGE R. SINNICKSON, resigned. H. H. GARRIGUES, engineer of maintenance of way, Southern division, becomes superintendent of the Delaware division, succeeding Mr. Smith. FRANKLIN DUANE, division engineer of the Baltimore division, succeeds Mr. Garrigues. W. F. MILLER, division engineer, Williamsport (Pa.) division, succeeds Mr. Duane as division engineer of the Baltimore division. N. D. VERNON, supervisor of the Maryland division, becomes superintendent engineer of the Williamsport division in place of Mr. Miller. W. L. BURT, assistant superintendent, Maryland division, has been transferred to the Baltimore division as assistant superintendent, and the position of assistant superintendent of the Maryland division has been abolished.

PHILIP GUISE, formerly chief engineer of the Mason & Hanger Construction Co. on the erection of the Charleston, S. C., army base, has been elected secretary to the newly created engineering board for the pier development of Jersey City.

WALTER S. OLSON, formerly lieutenant, Chemical Warfare Service, U. S. Army, has been appointed office engineer by the Commissioner of Drainage and Waters of Minnesota, St. Paul, Minn.

JAMES R. POLLOCK, assistant engineer, Illinois State Board of Health, has joined the city engineer's staff in Flint, Mich., and will make an investigation of the sewage disposal problem.

A. W. VERHAREN has been appointed city engineer of Helena, Mont.

FREDERICK L. FORD, formerly city engineer of Hartford, Conn., and recently city engineer of New Haven, has resigned to become vice-president and general manager of the Connecticut National Pavements, Inc., just organized, which will take over the rights of the National Paving Co., with headquarters at New Haven.

CAPTAIN A. M. DAVIDSON, assistant division engineer, Baltimore & Ohio R.R., at Cleveland, has been promoted to assistant trainmaster at Portsmouth, Ohio. CAPTAIN P. W. ELMORE, assistant engineer, Indiana division, has been promoted to assistant division engineer at Toledo. LIEUTENANT J. W. PURDY, assistant engineer, Ohio division, has been promoted to assistant division engineer, at Chillicothe, Ohio. MARK H. BEARD has been appointed assistant division engineer, Cleveland division, at Cleveland.

F. P. MOFFAT, of Winnipeg, formerly senior division engineer on the

Hudson Bay Ry., is now in the employ of the Canadian Department of Railways and Canals in connection with the valuation of the Grand Trunk Ry. System, preparatory to its being taken over by the Canadian Government.

J. E. BYERS, filtration plant superintendent at Twin Falls, Idaho, has resigned to accept a position with Burns & McDonald, Kansas City, Mo. He is succeeded by L. G. Satterly.

CLARENCE WILSON has been appointed water superintendent at Montpelier, Idaho, to fill the vacancy caused by the resignation of W. J. Barnes.

H. J. FINEBAUM, formerly engineer, Shipyard Plants Division, Emergency Fleet Corporation, at Philadelphia, on the design of floating drydocks, is now assistant engineer in charge of the office of C. W. Hudson, consulting engineer, New York City.

PHILIP BARON, for the past several years associated with Thomas L. Tomlines, consulting engineer, Syracuse, N. Y., in paper mill design and construction, has accepted a position with the St. Regis Paper Co., Deferiet, N. Y.

LIEUTENANT-COLONEL E. B. MORDEN, recently provisional appointee, has been appointed permanent chief of the Bureau of Street Cleaning of Philadelphia. During the war Colonel Morden was constructing quartermaster at Camp Custer, Battle Creek, Mich., and subsequently constructing quartermaster of the Philadelphia Army Supply Base.

ELWYN E. SEELYE, consulting engineer; EDWIN A. FRASER, formerly with the Truscon Steel Co.; A. L. STEVENSON and C. H. HAMILTON have formed a partnership under the firm name of Seelye & Fraser, with offices in New York City. A. L. Stevenson will have charge of the designing department and C. H. Hamilton of the concrete detailing department. An associate structural steel detailing company has also been formed under the firm name of Seelye & Tarbell. CHARLES E. TARBELL for a number of years was connected with the Westinghouse, Church, Kerr Co., and during the war was structural engineer on the $60,000,000 Government nitrate plants at Toledo and Cincinnati.

G. C. KOONS, assistant division superintendent of the Pennsylvania R.R., at Miffintown, Pa., has been appointed assistant chief engineer, with office at Philadelphia.

EDMUND S. DAVIS will retire as chief engineer of the Boston Transit Department on July 1. As an engineer of the department for the last 25 years, and for eleven years chief engineer, he has been connected with the construction of all of the Boston subways. In his present absence from the department, on leave, Ernest R. Springer, assistant engineer, is acting chief engineer, but no permanent appointment will be made until the vacancy actually occurs by the retirement of Mr. Davis.

COL. CHESTER HARDING, Corps of Engineers, U. S. A., Governor of the Panama Canal, has, at his request, been placed on the retired list of the Army, with the rank of brigadier-general.

F. L. FRANCISCO, city representative on the Board of Supervising Engineers, Chicago Traction, has resigned and will give his entire time to his consulting practice as a member of the firm of Francisco & Jacobus, New York and Chicago.

W. R. HOLWAY, president, Holway Engineering Co., Tulsa, Okla., has been retained as consulting engineer by the city of Tulsa to advise in water and sewerage problems.

E. L. BRANDT, assistant engineer in charge of special work on the Michigan Central R.R., has been made assistant secretary of the American Association of Engineers in charge of the railroad department.

NICOL, GOULD & REDMAN is the name of a new engineering firm established by DAVID A. NICOL, recently highway engineer of Saginaw County, Mich.; FLETCHER A. GOULD, formerly professor of civil engineering at James Millikin University, and CHARLES H. REDMAN, an engineer of thirty years' experience in municipal, railroad, drainage and appraisal work. The firm is located in the Mercer Building, Saginaw, Mich.

OBITUARY

D. O. ROBINSON, superintendent of construction on the Hetch Hetchy project in California, was recently killed in an accident on the site of that work. He was formerly mechanical superintendent on the construction of the Lower Otay Dam at San Diego, Cal., completed in 1919.

COLONEL THOMAS MANN RANDOLPH TALCOTT, civil engineer, died at Richmond, Va., May 7, aged 82 years. He was born in Philadelphia, in 1838, one of the sons of Captain Andrew Talcott, formerly of the Corps of Engineers, U. S. Army. When his father was appointed chief engineer, in 1858, of the Mexico & Pacific R.R., now the Mexican Ry, between Vera Cruz and the City of Mexico, he accompanied him as his personal assistant. When the Civil War broke out Colonel Talcott was commissioned first lieutenant of engineers in the Confederate Army, under General Lee, and assigned to the river, coast and harbor defense of the State of Virginia. At the close of the war he returned to Mexico and had charge of construction as division engineer of the Maltrata incline between Maltrata and Boca del Monte. Upon his return to the United States, about 1867, at various periods Colonel Talcott served as assistant engineer, Louisville, Lexington & Cincinnati R.R.; division engineer, Chesapeake & Ohio R.R.; general manager, Richmond & Danville, now the Southern Ry.; vice-president and general manager, Mobile & Ohio R.R.; assistant to the president of the Seaboard Air Line Ry., and, in later years, as vice-president, and general manager, Tidewater & Western R.R. He was a member of the American Society of Civil Engineers from 1886 to 1898. Colonel Talcott was also the author of a book entitled "Cost of Transportation by Rail."

HOMER HAMLIN, consulting engineer, of Los Angeles, whose death was noted in these columns last week, was born at Pine Island, Minn., in 1864. He entered the city engineer's office at San Diego, Cal., as assistant, in 1887, and was successively leveler on construction of the city sewerage system and assistant city engineer in charge of street grading and paving, sewers and water-works. He also made the surveys for the construction of the San Diego cable and electric railways, and superintended the construction of the Coronado Beach outfall sewer. In 1895 he was draftsman in the county surveyor's office at Los Angeles, engaged in the preparation of estimates on street improvement and sewer construction. He was appointed chief deputy city engineer in 1900, and in that capacity made a geological survey of the San Fernando Valley for the city water supply, and prepared plans for the extension of the city sewerage system. The following year Mr. Hamlin became engineer of the U. S. Geological Survey on hydrographic and geologic surveys in California, making surveys of reservoir and dam sites for Salinas Valley and designing dams, tunnels and other structures for the storage and use of the flood waters of that region, finally preparing a general report on the project. In 1903 he was placed in charge of the Division of Hydrology of California, mapping underground and artesian water supplies and the amount of irrigated and irrigable land. Following that work he designed dams, canals and levees for the reclamation of land along the Colorado River for the U. S. Reclamation Service. He was appointed city engineer of Los Angeles in 1906, from which office he resigned in 1917 to enter private practice as an engineer and geologist, specializing in surface and underground water supply, sewerage, sewage disposal, irrigation, land drainage and municipal engineering problems. He was sent to Washington by the Salt River Valley Water Users' Association because of his familiarity with the situation, to present to the Secretary of the Interior the desirability of the construction of the Paradise-Verde Project in Arizona. During the past two years he spent considerable time in Phoenix in the compilation of reports for the Reclamation Service and for the Water Users' Association on the proposed development.